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EDITORIAL

MOTOR TRUCK DATA We have frequently called attention to the series of articles on "Motor Truck Operation and Accounting" which we are publishing and do so again because they will be found to contain a large amount of data on the economy of the motor truck under all conditions and kinds of work, enabling the contractor and other user of trucks, present or prospective, to see just what results other truck users have been able to attain in the line of economy and efficiency. The articles have been placed in the new section of "Motor Trucks in Public Service," on a colored insert started last month, as the most convenient location for the reader.

CHICAGO SMOKE PROBLEM PRECIPITATED There have been some indications that the committee engaged in the study of the Chicago smoke problem was making an exhaustive study of the situation and the proposed methods for its relief, and occasionally some result of one or more of the special investigations has been published, but the vast magnitude of the work done and the thoroness and completeness with which it has been done, as shown by the final report made by the committee, will astonish every one, engineer, financial expert and layman alike.

No question which has been asked is left without a definite and authoritative answer, and many questions not heretofore arising are equally well taken care of.

The thousands of millions of dollars involved in the partial solution of the problem by means of the electrification of the railroad terminals, which was the particular method assigned to the committee for most exhaustive study, are set out in considerable detail. The conclusions of the committee as to the inadvisability of adopting this method of reducing the smoke nuisance on railroad lines above ground are those which will be attacked most vigorously. The detail of the report is such that the data leading to this conclusion are all before the critic and he must first demonstrate that the data are incorrect before he can make much headway in overthrowing the reasoning which leads to the logical conclusions stated. In the face of the expert engineers engaged on the daily work of the committee and those acting as consulting engineers for the various departments of the work, the scientific methods of observation used, most of them developed on the work, and the freedom with which methods and results of observation are stated, it would seem to be impossible to attack successfully any part of the report.

It will long stand as a model of its kind and will seldom, if ever, be equalled by any document of its class.

ELECTRIFICATION OF RAILROADS As a corollary to the report of the Chicago committee on smoke prevention and railroad electrification is the discussion of the electrification of the lines running into the Broad street station, Philadelphia. This follows the lines of the electrification in New York, Baltimore and other places, but does not contain the tunnel feature, which was one of the leading reasons for their change in motive power. It will be resorted to, if at all, not because operation is cheaper than by steam, but because it may be possible to operate the Broad street station with the new system without subjecting it to extensive alterations at heavy capital cost. This is a particular situation to which electrification seems well adapted and the increase in cost of operation is offset by the saving of interest and depreciation on the new construction that would be necessary if the use of steam were continued.

Extension of the electrification over lines running to the station naturally follows, and will doubtless be extended over the suburban district, at least in part. Extension to the main line between Philadelphia and New York is also suggested, but will probably not be undertaken until the economy of the system is more fully demonstrated.

It should be remembered that all this proposed electrification is of passenger lines and is not primarily a smoke prevention measure; also, that the problem is not complicated by the switching of freight cars, which is such a large proportion of the work in Chicago, where anything which stopped short of complete electrification of freight and yard movements as well as passenger would have scarcely an appreciable effect upon the quantity of smoke produced in the city, the elimination of which seems to be the most important feature in the Chicago project.

SMOKE PREVENTION IN CHICAGO

AND ELECTRIFICATION OF RAILROADS

The Committee of the Chicago Association of Commerce on Investigation of Smoke Abatement and Electrification of Railway Terminals has been at work for about four years and a half on an investigation of these great subjects and has expended a large amount of money thru a large and well organized force of experts and assistants in all the engineering and financial lines involved. Its monumental report containing a half million words has just been published and is the most complete and comprehensive statement of the conditions, what may be done to relieve them, what the results will probably be, and what cannot be done which has yet appeared. Even the Pittsburgh work, heretofore considered to be extensive and valuable seems infinitesimal by the side of this massive report and the vast amount of work behind it. A very brief abstract of the results of the investigation and the conclusions of the committee is given. Some details will be given from time to time in future issues.

The complete electrification of the Chicago railroad terminals as a means of abating smoke is technically practical but financially impractical. This is the finding of the Chicago Association of Commerce Committee of Investigation on Smoke Abatement and Electrification of Railway Terminals which has been studying the problem since early in 1911. The committee, in addition, holds that the elimination of the steam locomotive alone would produce a hardly perceptible betterment of the Chicago atmosphere, and urges the appointment of a permanent Municipal Pure Air Commission which, thru both instruction and coercion, shall reduce all sources of air pollution to a minimum.

The association committee, as a result of its painstaking investigations, reaches the following conclusions:

That the minimum cost of electrification as a means in smoke abatement would be.....$178,127,230

That the more probable cost, due to the necessity for improvements and re-arrangements, which would be precipitated by electrification, would be $274,440,630

That the least net annual operating deficit produced by electrification would be.....$ 14,609,743

That Chicago, under the state constitution, cannot aid in meeting this expense.

That an arbitrary or tax on terminal traffic to support the capital for electrification would constitute a burden upon the business interests of Chicago.

That the cost would be so heavy that no court would uphold an electrification ordinance.

That the Chicago electrification would equal the combined electrifications of the whole world, would involve problems never heretofore met, and would be the first ever undertaken for air betterment where terminals were adequate from an operating viewpoint.

That before the steam locomotive is eliminated pollution must first be reduced to a minimum from the three more damaging services, high pressure steam plants, metallurgical and other manufacturing furnaces, and domestic fires.

That the steam locomotive stands third among smoke producing services, using but 12 per cent of the fuel consumed, and that its elimination would reduce the gaseous pollution of the air only 5 per cent and the solid pollution less than 4 per cent.

That electrification, hydro-electric and other long-distance transmission being inapplicable, would add power-house smoke in quantities sufficient to offset much of the gain thru elimination of locomotive smoke.

That suburban passenger services, such as those of the Illinois Central and other roads, produce but 1.54 per cent of the total visible smoke, and 1.97 per cent of all the dust and cinders.

That electrification will involve at least 3,476.4 miles of track.

That electrification would subtract only 1,291,282 tons of coal from the total of 21,208,886 tons now consumed annually.

That all smoke regulation in Chicago and elsewhere has erred in confining itself to the visible aspects of smoke, whereas the really harmful factors are the invisible gases and the solids of combustion, sulphurous gas and mineral dust in particular.

That Chicago air is polluted annually by the introduction of 304,391 tons of soot, dust and cinders and of 5,008,111,106,758 cubic feet of sulphurous and other gases.

That, despite the fact that Chicago burns more coal annually than any other large city—eight tons per capita as against four for Manchester and one and one-half for Berlin—its air is better than that of most large cities.

That Chicago air has the benefit of better sun, wind and rain conditions than that of most other cities.

That the loop is the smokiest district, with the stock yards and South Chicago a close second and third.

That, in Chicago air, the products of combustion constitute only two-thirds the total pollution, the other third being due to avoidable and unavoidable dirt from the general activities of the city and from poor municipal housekeeping.

In the report of its world-wide investigation, which is now submitted in a volume of more than 500,000 words, the Committee suggests what it says is the only program by which air pollution in Chicago may be reduced to the minimum.

These recommendations are based upon the conviction that pure air is essential to the health and comfort of an urban population, and that it is the imperative duty of the authorities of the city of Chicago to secure, thru persistent and intelligent action, a clean atmosphere. The Committee's recommendations are as follows:

(1) That there be created by the city, a permanent Pure Air Commission, the membership of which shall be made up of persons possessing high technical qualifications.

(2) That financial support be placed at the command of the Commission, which shall be sufficient adequately to provide for the organization and development of investigations of a highly scientific character.

(3) That the Commission be empowered to investigate all sources of air pollution, to determine, by experiment or otherwise, the most effective means for mitigating or eliminating such pollution, and that, so far as practicable, it be invested with power to enforce obedience to its decisions.

(4) That no materials shall be employed in paving, without the consent of the Commission, to the end that dust-creating pavements may be abolished.

(5) That the paving and cleaning of alleys and other highways shall be subject to the supervision of the Commission.

That the Commission shall have power to require that the wrecking and erection of buildings shall proceed by methods which will protect the air from all unnecessary pollution.

(7) That the Commission shall have the power to require roofs to be cleaned and other minor sources of air pollution to be abated.

(8) That new installations of boiler and other furnaces be permitted only as licensed by the Commission, which shall

have power, under reasonable rules to determine the character of the installations.

(9) That the Commission be charged with the duty of investigating present practice in the construction and operation of domestic furnaces, with a view to so perfecting such practice that fuels now used may be burned without objectionable air pollution, or to so changing the character of present fuels as to accomplish the same result.

(10) That the Commission be charged with the duty of investigating the construction and operation of metallurgical and high pressure steam boiler furnaces, with a view to eliminating, so far as practicable, the air pollution for which such furnaces are responsible, and that it formulate and enforce regulations under which such furnaces shall hereafter be constructed and operated.

(11) That the Commission be charged with the duty of investigating the pollution of the air by railroad locomotives, by steam boats and by other transportation agencies making use of movable engines, of devising methods of abating air pollution from these sources, and of enforcing such provisions for the suppression of air pollution as may be found necessary.

It is not the opinion of this Committee that radical action should be expected of the Pure Air Commission, or that action involving abandonment of the use of Illinois and Indiana coal is either advisable or practicable, or that action involving the general abandonment or rebuilding of existing boiler or heating plants, either stationary or portable, is advisable or practicable, or that the immediate or general electrification of railroads for the purpose of eliminating their part in air pollution is under present conditions advisable or practicable, but that all efforts to improve existing conditions shall be carried on with due regard to the responsibility of each of the fuel consuming services for their contribution to the pollution of the atmosphere, and that such changes as may be determined upon may be gradually made, with due regard to financial and mechanical difficulties.

As regards the financial practicability of electrification the Committee submits these findings:

(1) The complete electrification of the railroad terminals of Chicago as a betterment to be brought about by the railroads thru the investment of free capital is, under present-day conditions, financially impracticable.

(2) Any procedure designed to bring about the complete electrification of Chicago's railroad terminals which is based upon a financial program involving municipal co-operation is, under present-day conditions, impracticable.

(3) Any procedure designed to bring about the complete electrification of Chicago's railroad terminals which is based upon the application of an arbitrary to traffic of Chicago, will constitute a tax which must be borne by the business interests of the city. The practicability of such a tax is a matter which has not been studied by the Committee.

(4) The preceding conclusions apply to the complete electrification of Chicago's railroad terminals. The financial practicability, under present-day conditions, of electrification as it might be applied to individual roads or to a single service of individual roads, is a matter which has not been investigated by the Committee and concerning which no opinion is expressed.

(5) The credit of the individual railroads, the properties of which make up the Chicago railroad terminals, differs greatly. Some have high credit and could secure funds for almost any project which their managements might care to propose; others must prove the profitable character of a particular project before underwriters would consider the placement of their securities; others would find it difficult to borrow on reasonable terms even if the particular project for which the funds are sought promises some return; and still others are in the hands of receivers, their administrative function being performed by the courts. These facts cannot be overlooked in estimating what portion of the potential credit of the railroads is available for the propose of electrification.

(6) Certain railroads making up the Chicago terminals operate entirely within the prescribed zone, while for others the great predominance of traffic lies outside the terminal limits. There is more to this contrast than is implied by the fact that some of the roads involved are switching roads while others are long-haul freight and passenger roads. Complete electrification, from a financial point of view, would affect but a relatively small part of the fixed investments of some roads, while for others it would require practically the rebuilding of the property.

(7) Electrification is a matter which may present greater advantages in connection with certain classes of service than with other classes of service; for example, the electrification of a railroad having a large suburban business would be more effective in developing opinion favorable to the railroad concerned than the electrification of a road the activities of which are wholly those of freight switching yards. A few only depend upon passenger traffic within the city limits for any considerable amount of their revenue. A larger number derive passenger revenue within the terminals from the movement of thru passengers only; while other roads perform little passenger service or no passenger service all.

(8) The extent to which individual railroads have recently made large capital expenditures for terminal improvements, track elevation and enlargement of facilities in Chicago, and the extent to which they are committed to further expenditure for these purposes, must have a material bearing on their ability to make expenditures for new projects.

The Committee holds that the city might well be expected to share in the burden of electrification, seeing that it would be undertaken for the public benefit, but a perusal of court decisions shows that this is impossible. A separate section of the constitution of 1870 has the following article:

No county, city, town, township, or other municipality shall ever become subscriber to the capital stock of any railroad or private corporation, or make donation to or loan its credit in aid of such corporation, provided, however, that the adoption of this article shall not be construed as affecting the right of any such municipality to make such subscription where the same have been authorized under existing law by a vote of the people of such municipalities prior to such adoption.

Moreover, the report points out that it would be impossible for the city, under present constitutional and statutory limitations, at least for some years to come, to raise the necessary funds without the issuance of bonds beyond the authorized limit.

The Committee, realizing that many public spirited citizens will not understand its decision, in the light of reports of electrifications in New York and elsewhere, points out the essential differences between electrification here and those installations that have so far taken place. Nowhere in the world, it finds, as a result of its investigations, has a steam railroad been electrified to avoid the pollution of a city's atmosphere. Nowhere has a terminal been electrified when that terminal from an operating standpoint has been satisfactory. No electrification in existence, either in America or abroad, is comparable, in scope and diversity of service, with that involved in the electrification of the Chicago terminals. A wide gap exists, the Committee reports, between that which has been accomplished and that which would have to be done before local electrification would become a success.

Some of the electrifications that have been most widely heralded as such, were in fact only a subordinate, though necessary, part of a greater scheme for terminal enlargement. The New York Central, the New York, New Haven & Hartford, and the Pennsylvania electrifications are not alone projects of electrification; primarily they are an essential detail of a new tunnel entry into the heart of New York City. These projects must necessarily stand upon a different basis than the Chicago proposal, where physical conditions absolutely requiring electrification are lacking and where physical conditions and the nature of the traffic would make electrification extremely difficult.

The Committee finds that elsewhere steam roads have been electrified for these reasons:

(1) Electrification has most frequently been employed in operating suburban passenger service.

(2) It has been used for all passenger service in connection with the intensive development of great passenger terminals where underground operation has been involved.

(3) It has been used for both freight and passenger operation in tunnels.

(4) It has been applied to sections of thru lines of route to improve operation of both freight and passenger service on difficult grades.

(5) It has been applied to sections of thru route lines

in anticipation of operating economies thru the utilization of water or other relatively inexpensive centralized power.

(6) It has been employed by a single railroad in this country in the operation of three switching yards, the work of which must still be regarded as being in an experimental stage.

Notwithstanding the engineering difficulties that would have to be overcome in electrifying the terminals, the Committee believe that these difficulties can be surmounted. Its work leads it to the conclusion that the only feasible means of electrification will be by the overhead contact system or trolley. Great obstacles exist to the installation of any system, but it is believed the trolley wire more nearly meets all demands than the third rail. The Committee states its conclusions as follows:

(1) A limited mileage of track in Chicago (approximately 1 per cent of the total) cannot be equipped with any system of contact. The electrification of this is not technically feasible.

(2) While the third rail system of contact might be extensively used in Chicago, there are, at intervals thruout a considerable percentage of the total trackage, conditions which would make difficult the use of this form of contact. The third rail is applied with difficulty wherever special track work abounds, where street and railroad crossings occur at frequent intervals, and in switching yards. In locations where employes must be between or must cross tracks, as in freight yards, it constitutes a physical obstruction which is highly objectionable. For these reasons the third rail is not considered feasible for general use in the Chicago terminals.

(3) The facts developed show that any form of overhead contact which can be placed high enough above the rail to give the clearance necessary to permit men to ride and perform necessary duties on the tops of freight cars, is not objectionable from a technical point of view. The application of an overhead contact system to the terminals of Chicago will, however, require the contact wire to be lowered in many places in order that it may pass under structures presenting minimum clearance. The great number of points at which the contact wire must be lowered will require the installation of many warning devices, or the enforcement of rigid rules governing the presence of trainmen on tops of cars."

The study of atmospheric pollution carried on by the Committee is said to be by far the most extensive and scientific ever attempted. Some of the methods used have been discribed in MUNICIPAL ENGINEERING and some preliminary results have been given, and others will be given from time to time.

A table in the report shows that in the industrial centers and the heavily populated districts the steam locomotive coal consumption and smoke production are small when compared with the total volume for all sources. In outlying districts where the population is small and where there is no grouping of industries, the steam locomotive sometimes becomes the greatest smoke producer.

In only four of twenty-seven districts do steam locomotives use more than half the total fuel consumed, and these districts are sparsely populated and have very limited smoke producing services other than smoke from residence chimneys.

For the purpose of its investigation the Committee considered smoke in the following aspects: Visible smoke, solids in smoke, gases in smoke.

Hitherto most discussions concerning smoke, and practically all measures designed to show the extent of atmospheric pollution resulting from it, have dealt only with its cloud effects, which are of secondary importance, the real problem being one of suppressing the shower of soot, dust and cinders constantly falling from a smoke polluted atmosphere. The amount of solids discharged has no direct relation to visibility. The adoption of anthracite coal or of coke as fuel, the Committee asserts, will serve to make stack discharges invisible but will not eliminate the dust discharge.

Metallurgical furnaces and other similar manufacturing fires were found guilty of producing 64.26 per cent. of all the solids due to combustion. High pressure steam plants produced 19.34 per cent.; low pressure steam and other domestic fires 8.6 per cent; and steam locomotives 7.47 per cent.

The metallurgical and manufacturing fires use 98.6 per cent of all coke used, which means that 78 per cent of their total fuel is of the so-called smokeless type. The explanation of their heavy polluting effect is found in the fact that 41 per cent of the solids sent into the air by their smoke stacks is not of fuel origin, but is drawn from the material being treated and is usually a metallic or mineral dust.

High pressure steam stationary power and heating plants are responsible for 44.5 per cent of the visible smoke, for 19.34 per cent of the total solids, and for 45 per cent of the total polluting gases of combustion: Within the city are approximately 17,000 high pressure (ten pounds or more) steam boilers, served by not less than 11,000 smoke stacks.

Low pressure steam and other heating plants (domestic fires) consume 23.63 per cent of the city's coal. They are responsible for 3.93 per cent of the visible smoke, for 8.60 per cent of the solids in smoke and for .23 per cent of the total gases of combustion. They are responsible for 57 per cent of the total hydrocarbons or sooty materials, which makes their smoke the most damaging of any to clothing and similar articles. There are more than 11,000 boilers with steam pressure of less than ten pounds and several hundred thousand domestic heating furnaces and stoves in houses and stores. This service ranks first in the consumpion of anthracite coal, burning more than 96 per cent of the total amount of such fuel consumed within the city of Chicago. Approximately 38 per cent of the total amount of fuel consumed by low pressure steam and other stationary heating plants in Chicago consists of anthracite coal, about 41 per cent is bituminous coal, 20 per cent semi-bituminous, and the remaining 1.0 per cent is coke.

For four months in the year no smoke is developed from fires; for four others months the amount developed is comparatively small. An annual average of 4 per cent of visible smoke from this service implies a period of from two to four months during which the contributions may be in excess of 15 or 20 per cent. During the period of its activity this service is, therefore, of far greater importance, as a source of atmospheric pollution, than would appear from the average values which have been set forth.

High pressure steam plants produced almost half the total gaseous pollution of the air, the exact figure being 44.96 per cent. Low pressure steam and other domestic fires produced 23 per cent, metallurgical and other industrial furnaces 21.13 per cent and steam locomotives 10.31 per cent.

The Committee finds that during the year 1912 steam locomotives poured into the air of Zones A and B 573,036,032,152 cubic feet of gases of combustion at 62 degrees Fahrenheit and thirty inches mercury pressure. High pressure steam plants in the same period poured out 2,330,472,654,745 cubic feet of gases of combustion, low pressure steam and other heating plants produced 1,068,812,470,587 cubic feet and metallurgical and other manufacturing furnaces produced 1,007, 88,426,826 cubic feet. The total production of gases of combustion for the year from all sources was 5,008,111,-106,758 cubic feet.

Notwithstanding the large volume of gaseous products of combustion which are emitted into the atmosphere of a city, the Committee found that little trace of them is disclosed by a chemical analysis of the atmosphere. The explanation is, of course, to be found in the fact that while the volume of the polluting discharge is great, that of the atmosphere affected is vastly greater.

The Committee's investigations convince it that the only gaseous elements which are harmful are those of sulphur which, in the air, change into sulphuric acid. The high pres-

sure steam plants are first as sulphur producers, the metallurgical and other furnaces second, the low pressure domestic plants third and steam locomotives fourth.

Steam vessels were found to contribute the smallest total toward the pollution of Chicago air. They consume 0.46 per cent of the total amount of fuel used. They are responsible for 0.74 per cent of the visible smoke, for 0.33 per cent of the solid constituents of smoke, and for 0.60 per cent of the total gaseous products.

Of the 437,000 barrels of naphtha and the gasoline consumed within the area of investigation, fully 85 per cent is consumed in automobile service. Automobile smoke whether visible or not, constitutes a polluting agency similar in general character, but differing much in detail, from that discharged from chimneys and stacks, is discharged near the ground, where its presence is most objectionable to pedestrians, and being more or less surcharged with oil, is especially offensive to those enveloped by it. Where the street traffic is most congested, the polluting effects are pronounced."

The superiority of crude oil, from the standpoint of smoke abatement, when used for industrial fires, is not questioned. The low sulphur content in the smoke from oil fires is an additional advantage. With proper regulation the smoke from oil fuels may be invisible, but under conditions unfavorable to perfect combustion, the smoke from oil fires becomes dense.

Illinois and Indiana coal is Chicago's coal and she must use it. While for the present Chicago draws heavily on more distant fields, she must ultimately satisfy her need from the local supply. Illinois coal, as compared with eastern coals, is high in volatile matter, including sulphur, and improved methods of consumption do not decrease the volume of sulphur gas produced. Furnaces which are satisfactory for coals low in volatile matter give off excessive amounts of smoke when Illinois coals are burned. Chicago's problem in smoke abatement, therefore, is complicated by the fact that the coals she must use are those commonly referred to as smoky coals. Yet, the Committee finds that notwithstanding this fact that the fact that Chicago burns more coal per capita than any other large city, Chicago air is much better than that of most large cities, particularly those with which it should normally be compared.

Chicago burns each year approximately eight tons of coal per capita, as against five tons per capita in Cleveland. Yet the amount of solids found in Cleveland air, according to data obtained, varied from 1.5 to 39.9 milligrams per cubic meter as compared with 0.321 to 1.958 for Chicago, or about twenty times as much, Cleveland air contained gaseous compounds of sulphur amounting to 33.019 milligrams per cubic meter whereas the sulphur values in Chicago air ranged from a minimum average of 0.217 to a maximum average of 1.104 milligrams per cubic meter. The amount of gaseous sulphur and sulphuric acid found in Chicago air is reported to have have been materially lower than that in other cities, with the exception of Hamburg, where the values were about one-tenth those of Chicago. Cleveland air had a soot content of 14.130 milligrams per cubic meter which was much higher than Chicago, and a carbon dioxid content of 4.06 parts per 10,000 which is higher than has generally been observed in foreign cities. Chicago, as regards carbon dioxid, was found by the Committee, to rank with the larger European cities.

Chicago air was found to be many times freer of ammonia than that of most large cities, and the chlorine content was also very small. Carbon monoxid, though a highly poisonous gas, exists both here and in other cities in amounts no larger, for practical purposes, than those of country air.

Chicago burns 17,500,000 tons of coal in Zone A per year as against 16,000,000 tons in London. But London's soot deposit reaches the total, unknown here, of 233 to 426 tons per square mile per annum. Outside the city the precipitation was only fifty-eight tons. During five months following November, 1904, London enjoyed rather less than half the sunshine of the inland stations of observation and little more than one-third those of English south coast stations. This is a loss unheard of in Chicago.

Chicago burns approximately eight tons of coal per year per capita as against one and one-half tons for Berlin. Yet the German capital suffers a deficiency in possible light amounting to from 15 to 16 per cent in winter and 9 per cent in spring. Berlin receives only 34.3 per cent of possible sunshine, whereas Chicago has an annual average of sunshine of 57.4 per cent. A haze is reported as almost always present in Berlin air.

Wind is an important ally in the campaign for pure air. So is rain. Chicago is fortunate, in being situated close to certain well-defined storm tracks which are responsible for winds of higher velocity than the average thruout the country. A seven-years' record from twenty-nine American cities shows that the average velocities for Chicago were exceeded by those of only three other cities, namely Toledo, Cleveland and Buffalo. The cleansing effect of Chicago winds was found to be nearly double those of Baltimore, New Orleans and the more important cities of the Pacific Coast.

Chicago has an annual rainfall of 33.5 inches whereas London has only 23 inches, which is about the same as Paris, Berlin and Hamburg. Chicago rainfall is well distributed for air washing. Cities which have a distinct wet and dry season, suffer especially from air pollution during the continuance of the latter.

The Committee investigated several methods of conducting transportation hoping that some satisfactory type of self-propelling motor might be found among them, the internal combustion motor with mechanical drive, electric drive, compressed air drive, hydraulic drive, direct connected motor; the compressed air motor; the hot water motor, and the electric storage battery motor.

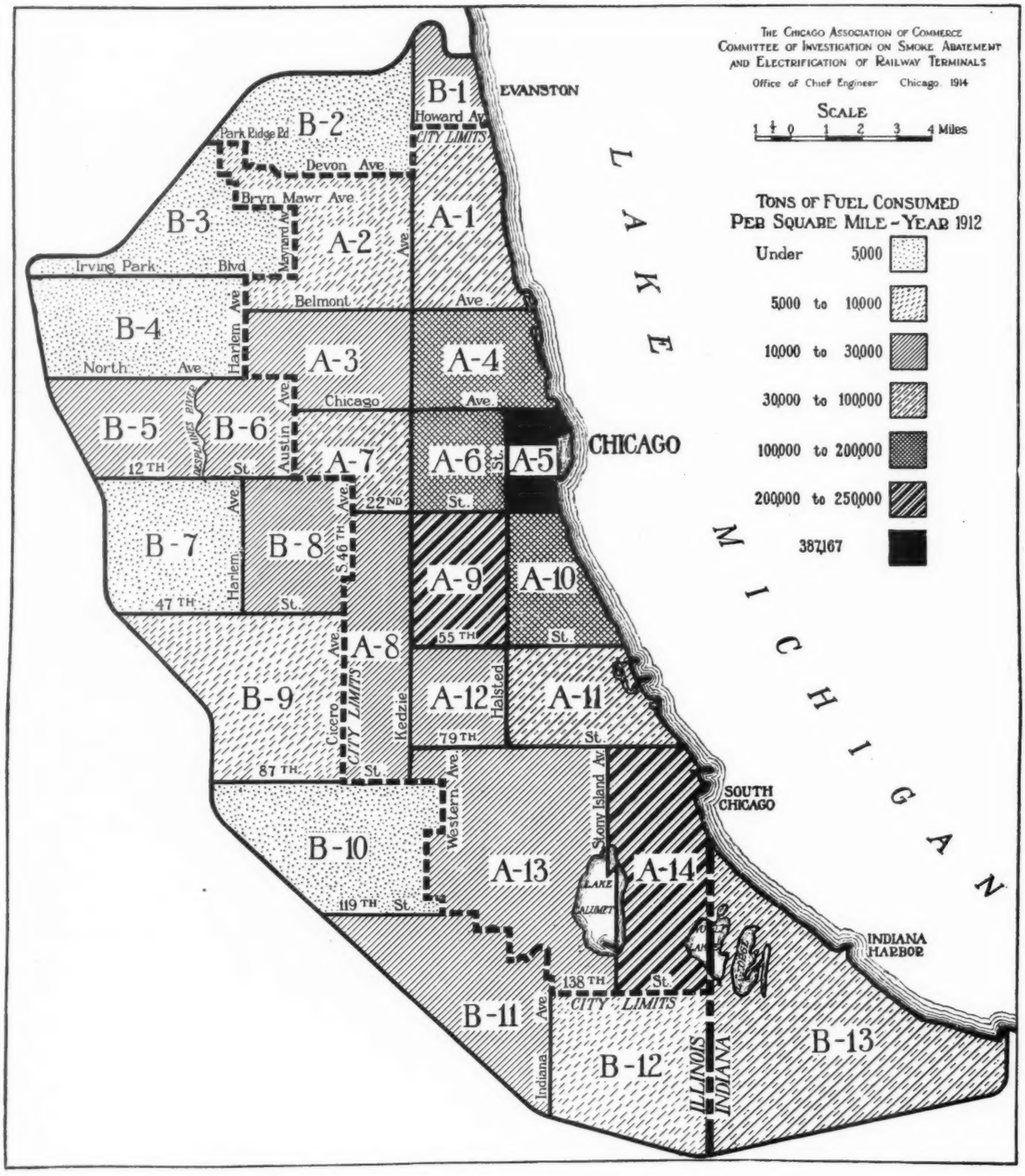
It was found that the power requirements of heavy and diversified traffic are still beyond the gasoline driven unit. The Diesel oil-burning marine engine has the power but neither type is self-starting, an imperative requirement for switching work. The inventor of a new Diesel experimental locomotive was doubtful of its success in heavy yard switching work and limits its future to light express work with constant speeds and infrequent stops.

Much, also, had been hoped from the storage battery, but it was found to lack power, to be too expensive and to share, with electrification, the disadvantage of producing power house smoke. The internal combustion motors are also smoke producing and are regarded as adding a new hazard of operation thru their fuel tanks. Compressed air and hot water motors were found impractical but their use is suggested on those sections of Chicago track that cannot be electrified.

There is available at this time no form of locomotive carrying its own power, capable of handling the traffic of the Chicago railroad terminals which could be substituted for the steam locomotive, and there is no prospect of the immediate development of any such locomotive.

Of fifteen American electrical installations, nine were undertaken because of operation in subways or tunnels, one as an experiment to test out economy in long distance passenger service, two to hold suburban business, one was equipped for initial electric operation because of charter requirements, and two for the purpose of utilizing water power instead of coal.

Of the foreign electrifications no English line conducts heavy electric locomotive service and none freight service except in a very minor degree, practically all being confined to suburban and interurban traffic handled by motor cars. In France there is electric locomotive operation to passenger



DISTRICT MAP *of Chicago, showing the areas into which the city and its vicinity were divided for the purposes of the investigation and their relative consumption of fuel. The districts marked A are inside the city limits, those marked B are outside. This map shows where the conditions of atmosphere are probably the most objectionable and those in which it is most advisable to apply methods of smoke prevention with expectation of securing tangible results.*

trains thru a subway entrance into an underground terminal; suburban motor car train service; and an experimental service for heavy grade lines where hydro-electric power may be substituted for steam. In Germany one line is a short one, operated only in experimental service, and two will come into service predicated upon the production of cheap power, either from very low-grade coal or from hydro-electric plants, and neither conducted on a freight switching service comparable with Chicago terminals. In Switzerland the lines are for tunnel operation and light multiple unit train service, utilizing cheap water power instead of the more expensive coal fuel. In Italy is a road which operates heavy electric service. The secondary lines in foreign countries operate a service resembling our interurban.

Thirty-eight steam railroads would be involved in the Chicago project, as against 37 for the rest of the world, 25 with passenger and freight service; 23 trunk lines; 13 with transfer or switching service only. Eight of the trunk lines operate trains into the Chicago terminals over the tracks of other companies. Twelve railroads operate wholly within the area of investigation.

Chicago mileage would be nearly twice that of all other electrically operated mileage in America, and, exclusive of foreign light service lines, would be about 15 per cent. greater than all existing electrifications in the world. The committee's plan involves several times as much yard track mileage as do all existing American electrifications. The number of electric locomotives required would be approximately four times that of all now in service in America and two and a half times the number in the whole world.

Of switching service, which constitutes 59 per cent. of the total locomotive mileage and presents a grave problem in that it has never been attempted electrically on a large scale, it has been ascertained that yard freight switching services, on the basis of car miles, is more than sixty-five times as great as that on all existing electrified steam roads in America.

No service elsewhere is handled electrically in any considerable volume except that on the Giovi Railroad of the Italian State Railways and on the New York, New Haven & Hartford Railroad in America. The latter operates, in part electrically and in part by steam locomotives, three freight yards having in the aggregate 72.7 miles of track, requiring about 90,000 electric locomotive-hours per year and handling about 2,500,000 car-miles per year in switching and transfer service. The freight yard traffic of the Chicago terminals aggregates approximately 3,430,000 locomotive-hours per annum and approximately 164,400,000 car-miles per annum in switching and transfer service.

In its study of air pollution the committee notes three considerations which tend to decrease the importance of electrification. Of the first of these it says that the fuel consuming industries of the city are expanding and the traffic of the city streets is increasing so that the elimination of an entire fuel consuming service would constitute no guarantee that the sum total of atmospheric pollution might not increase subsequently to even greater amounts.

Secondly: The comparatively small reduction from electrification is less significant in view of the substantial progress in reducing locomotive smoke from improvements in locomotive design and operation.

On the third point the committee states that electric operation of the railroad terminals requires a steam-driven electric generating station, which it would locate near the Chicago river and Ashland avenue. It would consume 807,762 tons of coal a year, a net saving of 1,291,282 tons over locomotive operation.

This would reduce visible smoke 20 per cent., solid deposits from smoke 5 1/3 per cent., and gaseous products of combustion 5 1/3 per cent.

The committee's plan contemplates the electrification of all track within the city limits, the mileage involved being 1,475.59 miles of main track, 1,456.64 miles of yard track, 277.19 miles of industrial track, and 37.26 miles requiring some self-propelling motor, a total of 3,476.40 miles. This includes certain lines partially electrified beyond the limit of complete electrification to the terminals of suburban service.

The committee, after obtaining complete engineering data on these three systems, selected the third as cheapest and most desirable:

1—Third-rail contact, direct current at 600 volts.

2—Overhead contact, direct current at 2,400 volts.

3—Overhead contact, single-phase current at 11,000 volts.

The committee finds that it would make no practical difference whether the roads manufactured their own electric power or purchased it from public service corporations.

Electricity would neither increase nor decrease the dangers of operation. New dangers would be offset by compensating safety in other directions.

The change would give some increased capacity in existing trackage and terminals; would contribute to celerity and reliability in train movement; would permit also more intensive use of railroad property by making double-decked freight and passenger terminal stations possible and the erection of buildings over tracks.

In arriving at the cost of electrification the committee based its work on 1912 operation, extended to meet conditions if electrification were to begin in 1916 and be completed in 1922. The minimum outlay would be $178,127,230 for construction.

The interest and depreciation on this sum, with about 1½ per cent. allowed for replacement of dissipated assets, amount to $16,946,436 a year. The estimated increase in net revenues is $2,336,693 a year, leaving an annual deficit on investment of $14,609,743.

Eight railroads have estimated the additional cost to them of work they must do to utilize fully the advantages of the general electrification, and the sum of their estimates adds 54.07 per cent. to the cost of general electrification given above. This makes the total capital necessary to raise for purposes of electrification at least $274,440,630.

Individual electrification by various roads, which refuse to join in the committee's plan of common installation and common operation, is also expected to raise the cost above the committee's minimum. One illustration makes this plain:

The committee assigns to the Chicago & Northwestern Railway a proportionate share in the cost of the common power station. The railroad itself, however, assumes at once that it would prefer an individual power station, and its estimates of the cost of the individual facility is $3,894,767. This is $1,683,936 in excess of the committee's estimates.

According to figures from the Michigan Central, costs of terminal rearrangement and improvement would amount to $5,000,000. Other railroads estimate such costs at one to ten millions, all additional to the committee's estimates, but not all attributable entirely to electrification, tho hastened by it.

The Chicago Association of Commerce has taken part in anti-smoke work actively since October 29, 1909, making its report on July 8, 1910. In March, 1911, the present committee was named, including four appointed by the mayor, four appointed by the railroads, and nine appointed by the Association of Commerce.

Horace G. Burt was chief engineer prior to his death in May, 1913, and W. F. M. Goss after June, 1913, with a full force of engineers on each specialty involved.

MUNICIPAL IRRIGATION SYSTEM
OF PROSSER, WASHINGTON

Western cities, many of them, must supply water for irrigation as well as for domestic, commercial and fire purposes. Prosser, Wash., avails itself of the water furnished by the Sunnyside project of the U. S. Reclamation Service and by carrying the water across the Yakima river is able to distribute it by a surface system over the ten zones in the city, a separate service from the regular domestic water supply system.

THE city of Prosser, Wash., has installed a municipal irrigating system of unusually effective attainments and one which affords an interesting example of community enterprise. Located in the Yakima Valley district of Benton county, this municipality is embraced in a division of the Sunnyside irrigation project of the Government, making available an adequate water supply from the main canal of this system by means of a siphon over the Yakima river.

Reinforced concrete pipe, 30½ inches in diameter, leads from this primary waterway and discharges into a 31-inch-diameter wood stave pipe line, reinforced with Johnson corrugated bars. This line crosses the Yakima river on a steel bridge structure, as shown in the accompanying illustration.

From this point the water empties into a reinforced concrete standpipe and is then conveyed to a Maginnis type flume and main distributing chamber, which is supported by wood bents mounted on concrete pedestals. This chamber serves as the initial source of supply for the city irrigation system.

Recognizing the possibilities of permanent water rights for local use, the city entered into contract with the Government for such privilege to provide for an irrigation season service of three acre feet within its corporate limits. This right embraced an expenditure of about $19,000, representing an approximate cost of $50 per acre for municipal territory, with transmission of water from the Government terminus by the city. Effective with this arrangement, a local distributing system to convey the water to all parts of the municipality was designed and installed under the supervision of Mr. C. D. Walter, now county engineer of Benton county.

To facilitate distribution the city was divided into eight zones or districts, each having a separate intake and capable of being shut off from the other zones by means of a gate valve. These zones are so arranged that one-half, or four, have their source of supply at the Government standpipe terminus noted, while the other four zones are fed primarily from headings on the west lateral main.

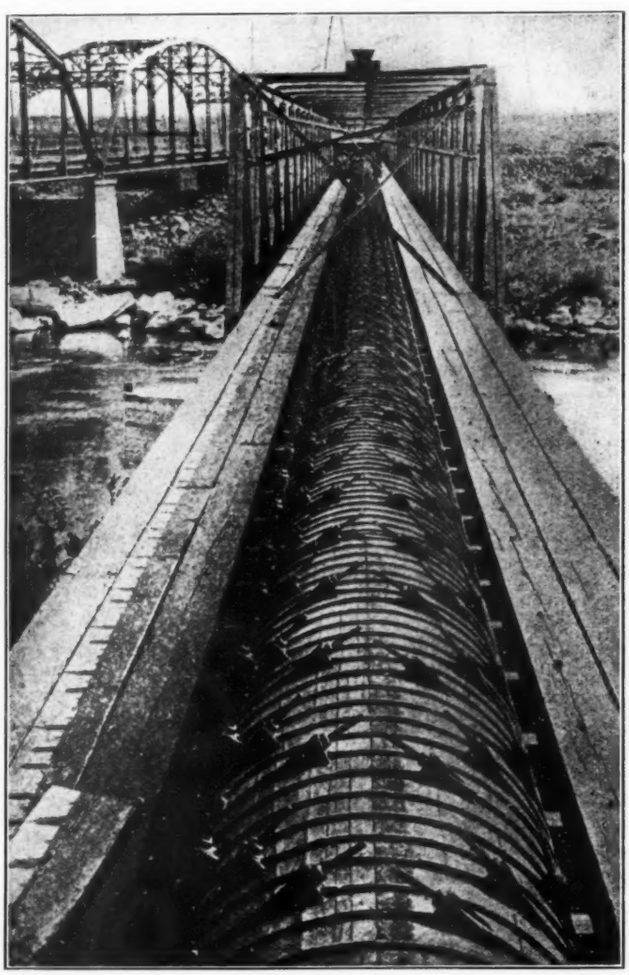
By this method an equally balanced water supply is obtainable at all sections of the city, ranging from 2 pounds per square inch along the Government canal to 30 pounds in the lower or central territory. Not only has this arrangement afforded economy in construction, but has proved highly efficient in operation, assisting to eliminate the necessity of a storage reservoir. The supply and pressure are capable of being fully maintained in periods of maximum or minimum demand.

Each of the eight zones is equipped with a ten-compartment reinforced concrete distributing box, which operates automatically. This box is located at the siphon standpipe, with connection by a short steel pipe line; the water, operated under a 6-foot head, is regulated by a 12-inch gate valve. From the first compartment of the distributing box, which forms a settling tank, the water passes over a weir to enter a general distributing chamber. Following, it flows into four division compartments, one compartment being for each district deriving service from this point. Subsequently, the water again passes over the weirs into chambers acting as pressure boxes for the main pipe line of each particular zone.

The distributing tank is so constructed as to eliminate any waste of water; if one zone is not employing its full quota of supply, the weir floods and the connecting zones receive the excess. Should all four zones fail to receive their allowance of water, the entire tank floods, being provided with walls sufficiently high to prevent any loss thru overflow.

The irrigation system proper is constructed of Matheson joint steel pipe, asphalt coated, testing to 600-pounds pressure. This pipe ranges in size from 10-inch trunk lines to 4-inch auxiliary branches, and 1-inch and ⅜-inch lot connections.

WOOD STAVE PIPE *carrying water from the Sunnyside main irrigation canal across the Yakima river to supply water for the irrigation of the city of Prosser, Wash.*



The total installation comprises the following: About 3,050 feet 10-inch pipe, 5,000 feet 8-inch pipe, 4,450 feet 6-inch pipe, 3,800 feet 5-inch pipe and 30,000 feet 4-inch pipe. For property connections, about 14,000 feet of the smaller size lines have been used.

These mains are laid out to reach every irrigable section of the city. Each tract or lot connection is provided for at the property line, one tap, with outlet at top, serving two adjacent properties on either side of the distributing main. As a typical example of outlet installation, a connection for two 50-foot lots in the principal city zone, with flow under 30-pounds pressure, comprises a saddle with 1-inch tap, one 1-inch nipple, one 1x¾-inch tee, two ¾-inch galvanized pipes leading to the respective property lines, and two ¾-inch corporation cocks equipped with plugs.

In the business district, five standpipes are installed for supplying the street sprinklers. In this as well as other sections of the city, adequate arrangement is made for water for street taps, taps being installed at close intervals to provide a flow of not more than two blocks from any outlet, insuring both ease of operation and control of water without waste.

The installation of this municipal irrigating system, exclusive of water rights, has cost the city of Prosser about $33,700, including engineering and legal expenses. Of this amount the steel pipe lines in place represent a total of $20,400, trench excavations and concrete structures have cost $5,000, while valves, boxes, fittings and pipe for lot connections bring the total expenditure up to the figure mentioned.

Prior to this installation, water for irrigating purposes was furnished by the Pacific Power & Light Company, which, with a limited well capacity, utilized the Yakima river as a source of extra service. This frequently resulted in an impure water supply, particularly during the excess demand period. With the operation of the municipal system, noticeable benefits have been derived. Land formerly allowed to grow wild has been placed under cultivation, gardening and kindred industries are on the increase and the beauty of the city is added to substantially. The municipal plant has proved a judicious investment, both in features of operation and attending results.

INCREASE IN MOTOR TRAFFIC

The accompanying diagrams show the increase in motor traffic on a main road out of Birmingham, England, and demonstrate the reasons for a reconstruction of the road which became necessary. They are of value as showing what may be expected upon the improvement of a road to the extent of making motor traffic easy and therefore of the necessity of taking account of this increase in designing the road so that it will be sufficient to carry not alone the traffic to which it is subjected at the time of construction but of the traffic given an opportunity to develop itself.

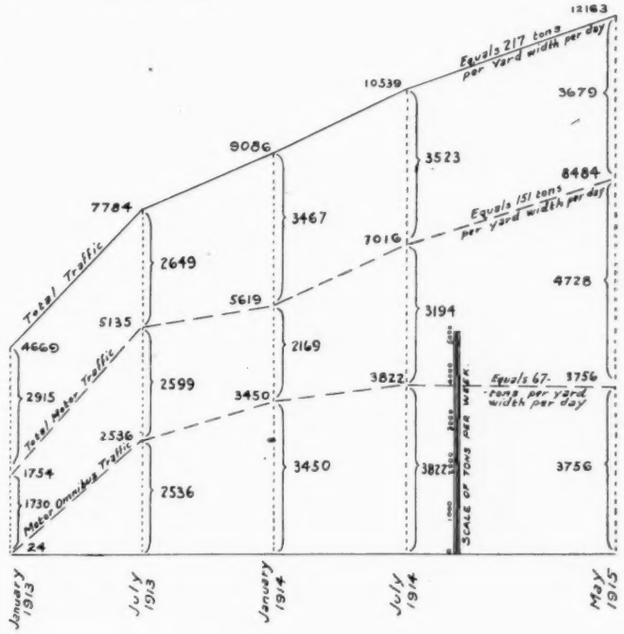
It will be noted that there was some 26 per cent increase in horse-drawn traffic but that the great increase was in motor traffic, it being five times a much at the end of two years and five months shown in the diagram as at the beginning, and that 55 per cent of the increase was in motor bus traffic.

The road on which the traffic census shown was taken was originally constructed with 6 to 8 inches of pebbles and granite surface on a dry marl bottom. In 1912 and 1913 the surface was tar painted and it gave good service until the motor-bus service began about January 1, 1913. This traffic increased to a maximum of 3,822 tons per week in July, 1914, and its slight decline was accompanied by a very material increase in other motor traffic. The road surface broke up immediately after the motor-bus service began and the road was reconstructed in 1914 as a tar macadam road, using the old road as a base, adding 5 inches of slag and 4 inches of tar macadam, with thoro drainage by means of slag shoulders under the outer edges of the road where it had been widened beyound the former width, connecting with side drains of tile.

It is not surprising that the light road first in use should go to pieces under the heavy traffic and it is quite possible that the tar macadam will do likewise after a little longer life.

The principal lessons to be drawn are that the traffic will increase and its character will change when the road is improved and therefore that the designer of the road must do his best to foresee the increase and changes and build his road to carry it. Otherwise his road must be rebuilt before it is paid for under the ordinary method of collecting road assessments, and paying road bonds.

There have been many such results on American roads but not many traffic census diagrams showing as clearly why the roads have failed as the one here given. It is taken from an article on modern traffic and its effect on improvement designs and maintenance cost in *The Surveyor and Municipal Engineer* of London, Eng.



Water Sterilization by Chlorine Gas

It is so easy to inject a little chlorine gas into a water supply which is a little doubtful as to sanitary safety that this expedient is resorted to with increasing frequency in supplies where the expense of filtration does not seem to be ordinarily justified. A small and convenient apparatus is here described and the main feature is illustrated.

THE usefulness and practicability of chlorine gas in purifying a surface water supply where the expense of filtration is not justified is being demonstrated in Wakefield, Mass., where a gas plant installed in September, 1914, is giving sustained efficiency. The average bacteria removal for the year has been about 93 per cent. an average of 254 bacteria per cubic centimeter being found in Crystal Lake, the source of supply, and 18 per cubic centimeter in the water delivered to the consumers. B. Coli were found in 17 per cent of the 75 samples of raw water and in none of the samples of treated water.

The town, which has about 13,000 population, takes its water from the lake on the outskirts of the town, much of the watershed being under cultivation and the houses unprovided with sewer connection. The supply is pumped directly into the mains, a standpipe taking the surplus. The Water Board did not feel justified in going to the expense of installing filters, as the growth of the town may require a new source of supply in 10 or 15 years. It called Edward C. Sherman, Boston, as consulting engineer, to advise as to an inexpensive means of rendering the present water safe for consumption. Sterilization by chlorine gas was recommended on account of simplicity of operation.

The plant, purchased from the Electro-Bleaching Gas Co., New York, consists of a tank for chlorine in liquid form, a control board for valves and gages, and an absorption tower. Opening of valves on the tank and control panel allows some of the chlorine to vaporize and pass through a copper tube to a reducing valve, where the pressure is changed from the tank pressure of perhaps 100 lbs. to 6 or 7 lbs. per square inch. Gages on the board show the respective pressures.

The gas then passes thru a rate-control valve and enters the tower, where it is absorbed by a small spray of water. The solution thus formed is then drawn into the suction pipe and mixed with the supply as it passes thru the pipe.

The rate of applying the chlorine is regulated by hand, changes in valve setting being required practically only when there is a distinct change in the raw water under treatment.

A rate control gage consisting of a conical glass tube, with a platinum float, shows the chlorine used, in ounces per hour. The rate of using the gas is checked by readings of the weight of the tank, which stands on scales, and from the records showing hours of pumping.

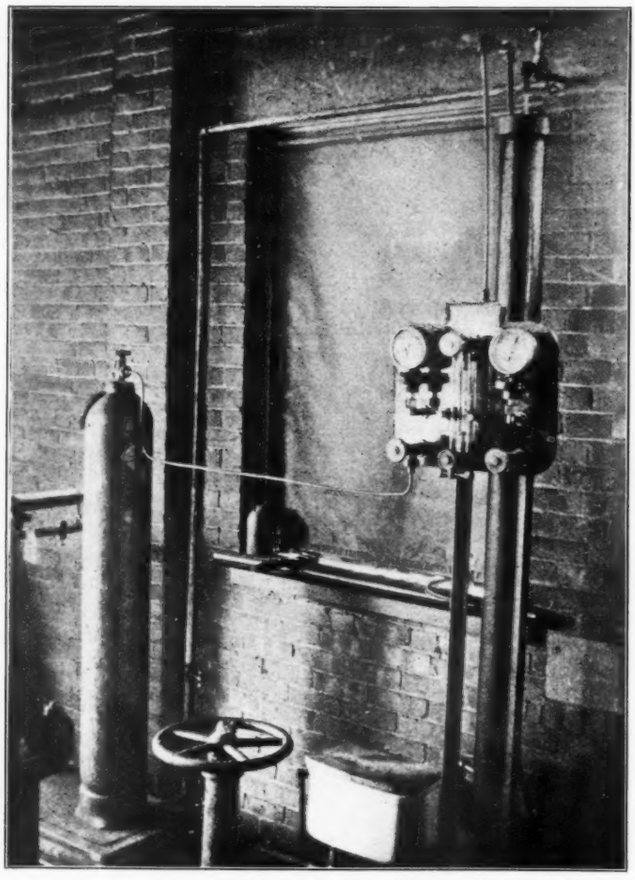
A small water tank, with a float valve and connected with the absorption tower, keeps a supply of water at a fixed depth in the bottom of the tower, the water for absorbing the chlorine being supplied thru a small pipe leading to the top of the tower. The apparatus room is kept at about 85 deg. F.

The cost of the plant in place was about $600, and the cost of operation, including chlorine, analysis of samples, supervision and interest, is approximately $1.25 per million gals. For the first year of operation the cost reached about $1.75 per million gals., owing to frequent examinations when the plant was started, and other items.

It is pointed out by Mr. Sherman that, although the results have been good in Wakefield, which has the first plant of the kind in the State, no method of sterilization can take the place of filtration, in that it cannot remove turbidity nor much of the color. The success of any process of treatment is dependent on the care and intelligence of those in charge.

The results secured at Wakefield involved the use of one part chlorine to 2,000,000 parts water, in December last, to a maximum of one part to 8,000,000, during a short period when a large amount of organic matter was washed into the reservoir. There has never been an unpleasant taste or odor in Wakefield water, but it is recognized that clarification by rapid filtration before being sterilized would make probable even better results than those secured, and with less chlorine.

CHLORINE GAS *apparatus and method of controlling the application of the gas to the water in an aqueous solution made immediately before injection into the supply.*



IMPROVING CONCRETE BY THE USE OF HYDRATED LIME

The use of lime in limited quantities in cement concrete has been advocated for a number of years and the extension of its proper use has usually resulted in improvement of the concrete in plasticity, greater impermeability, prevention of shrinkage cracks to a considerable extent, greater uniformity of the mass of concrete and the like. This article gives the reasons for many of these improvements and reports of the results of the application of the theories in actual construction and is well worth careful study.

THE direct effect of the addition of hydrated lime to cement mortars and concretes has been found by many prominent engineers to produce certain characteristics in the concrete which are of marked advantages in bringing about concrete of superior quality.

The functions of hydrated lime in the concrete are as follows:

1. Increases the plasticity and homogeneity of the mass, facilitating the mixing, handling and placing.
2. Reduces to a minimum tendency towards segregation.
3. Causes the retention of a sufficient amount of moisture in the concrete, while setting, to reduce the risk of shrinkage cracking.
4. Being a void filler, it renders the concrete less porous and more impermeable, largely reducing the alternate absorption and expulsion of moisture, thereby minimizing expansion, contraction, internal stresses and cracking arising from changes in moisture content.
5. Produces density and uniformity in the finished concrete, thereby adding to the life and efficiency of the structure by elimination of stone pockets and weak sections as well as other sources of irregularity in strength.

Plasticity and Homogeneity.

During the time of mixing and placing concrete, and up to the time it begins to harden, concrete may be considered as a plastic material. The term plastic as used in reference to concrete and cement mortars may be defined as that property which allows the material to be cast or molded into shape.

It may be said that the plastics differ from most materials of construction in that their strength and structural integrity depend to a much greater extent upon the skill of the user than upon that of the manufacturer. For example, portland cement is made by most manufacturers to pass a standard specification and if portland cement of this character is used it may usually be depended upon to perform its particular function, so that it may be stated that the quality of concrete is much more dependent on the quality of stone, sand and workmanship than upon the cement. It will be readily recognized that the quality of the concrete is largely dependent upon its plasticity, or the ease with which the plastic mass of stone, sand, water and cement will flow into place and assume its final form. This being the case, anything that will improve the plastic quality of the wet mixture without decreasing its strength after hardening will be found advantageous.

The value of concretes and mortars in construction work depends upon the ease of manipulating them into a plastic state, supplemented by the quality of subsequent hardening to a stone-like mass. It is a well known fact that cement when mixed with water is not very plastic and it is therefore difficult to secure its elevation, pouring and distribution without more or less sticking and clogging in the chutes. It is in endeavoring to overcome this lack of plasticity hat an excess amount of water is used, which usually results in the concrete becoming too wet, causing the aggregates and matrix to separate. This naturally prevents a uniform distribution of the cement thruout the mass, upon which factor, together with proper grading of the fine and coarse aggregates, the durability of the concrete is more dependent than it is upon the proportion of cement used, provided, of course, the amount of cement used is consistent with the required loads.

As is well known, it has been demonstrated by experiments and practical observations that lime is a much more plastic, freer spreading material than cement and the practical result of the addition of small percentages of this material (5 to 15 per cent. of the cement content) has been found to be material promotion of plasticity thruout the mass. The effect of this added plasticity is to smooth out and lubricate the way for the sharper pieces of stone, sand and cement to flow freely in transit and without segregation so that the concrete is deposited in the forms with the cement uniformly distributed thruout the mass, resulting in maximum strength. After the concrete has been placed in the forms, subsequent spading is greatly facilitated and the thoro covering of intricate reinforcing steel is more perfectly accomplished. An extremely interesting example of the effectiveness of hydrated lime in correcting lack of plasticity in concrete as related by Robert S. Edwards, Chemical Engineer, Portland, Oregon, is worthy of mention:

"During the fall of 1912 and the winter of 1913 the Stone & Webster Engineering Corporation constructed a large concrete dam located on the White Salmon river, about seventy miles from Portland, Oregon. Our concern was retained by Stone & Webster and the Northwestern Electric Company, for whom the dam was built, to inspect the material used in the concrete work. A thoro investigation was made to determine the advisability of manufacturing the sand which was to be used in this work, and it was finally decided to erect a large crushing and sand manufacturing plant and secure both fine and coarse aggregate for the concrete in this manner. The sand was made by further crushing a basaltic rock secured from the crusher located on the bank of the stream at an elevation of 600 feet above the river bed. The fine crushed rock was screened through a ¼-inch mesh, and the fine and coarse crushed rock stored in bins just above the mixing plant, from which point 80 per cent. of the concrete was poured down a spout or chute 400 feet in length to the dam site below. From numerous test results it was decided to use 10 per cent of hydrated lime thruout the concrete, the mixture being 1-3-6. It is more difficult to secure easy working concrete when using crushed rock as the coarse aggregate than when using gravel, this being due to the angularity of the crushed rock. In this case we not only had to contend with the crushed coarse aggregate, but sand-sized material was also angular, in fact, to such an extent that the concrete mixture would not flow down the steel-lined chutes without mechanical

aid. By the addition of 10 per cent of hydrated lime, or approximately 40 pounds of hydrated lime per yard of 1-3-6 concrete, we literally transformed the physical appearance of the concrete as seen in the chutes. The concrete would leave the mixers, pass into the chutes and then onward without the slightest separation of the aggregate and would finally arrive at the dam in a perfectly homogeneuos mass, where it would flatten out to a level with but little shoveling and spading in the forms. The hydrated lime, together with proper mixing, had given the concrete sufficient plasticity to destroy the excess friction caused by the angular condition of the fine and coarse aggregate, and formed a smoothly flowing, uninterrupted stream of concrete, to be deposited in its final resting place in the dam."

Retention of Moisture by Hydrated Lime.

A sponge-like colloidal matter with its immense surface and fine pores offers the greatest resistance to the passage of water, and while the final hardening of cement is obtained largely thru colloidal action, mortars made from them contain practically no colloid, in consequence of which they are short and non-plastic and offer little resistance to the loss of water. This is due to the slow solubility of the cement. As the final hardening of cement depends upon the amount of water which is accessible to the fine grains of cement, it is to be expected that if concrete contains more material which will pass off water to the cement as required, there will be further hydration of the cement and consequently greater final strength.

Hydrated lime, as is well known, has a great affinity for holding water, which is mechanically retained in the mixture until such time as the cement requires more moisture to cause further hydration, at which time it is taken from the hydrated lime, thus producing maximum strength. This feature is of particular value in the construction of concrete roads. In laying concrete for this class of construction there is usually more or less loss of gaging water, either by seepage thru the subgrade or by evaporation. This loss in gaging water causes shrinkage, which takes place when the concrete is still young and without sufficient strength to resist the strain. This is very often the cause of very small shrinkage cracks which develop in concrete road construction. Many highway engineers have used hydrated lime as a means for reducing this difficulty to a minimum, the idea being that hydrated lime acts somewhat as a reservoir inside the concrete and passes off moisture to the cement as required, thereby offsetting the shrinkage action until such time as the concrete has gained sufficient strength to itself withstand the strain.

Value as a Waterproofing Material.

The value of hydrated lime as a waterproofing material has never been widely exploited and consequently is not as well known as it deserves. It has, however, been successfully used as an integral method of waterproofing such structures as dams, reservoirs, sewers, tanks, tunnels, bridges, etc.

Field practice has shown that in order to have concrete made permanently watertight it must be made so as to be productive of the greatest possible density. This necessary degree of density is obtainable thru the judicious use of hydrated lime, owing to its degree of fineness, permitting the filling and closing of voids. This results in a dense, impermeable concrete, and its power of imparting impermeability is retained so long as the structure endures.

Expansion and Contraction.

It will be appreciated that the degree to which concrete is made watertight will have more or less to do with the change in volume-constant of the concrete.

It has been definitely established that concrete expands and contracts somewhat under the influence of heat, and more markedly under the influence of alternate wetting and drying. It is therefore to be supposed that in making the concrete dense and impermeable by the use of hydrated lime, the volumetric movement of the concrete would be minimized.

In view of the foregoing, it is reasonable to assume that a material which performs these functions merits the consideration and investigation of engineers and contractors in designing and erecting concrete structures of any kind, and especially so when it is considered that hydrated lime is a low-priced commodity.

SWIMMING POOL AND FLUSH TANK

Municipal swimming pools are becoming frequent in California, even in cities of small population. Oakdale, Cal., was the pioneer in the movement, and now there are dozens of similar pools in the state. Oakdale is a city of but 1,500, a hundred miles from San Francisco, and has been incorporated only a few years.

The pool was built above the ground and was designed by George L. Dillman, a San Francisco engineer, who was then city engineer of Oakdale, to be used for flushing the sewers.

Now it serves a double purpose, for both swimming and flushing the sewers, so that it would probably be possible to induce even the more practical and conservative city fathers to consider the proposition. The pool was built by the city two years ago at a cost of $1,400, and since then about $500 additional has been spent in bathhouses, showers, buildings, etc. It is an ellipse, sixty feet long and forty feet wide at the widest point. It is built entirely above ground and the concrete shell is strengthened by earth, scraped up around the sides of the pool. The tank runs from one to nine feet in depth, holds approximately one hundred thousand gallons and the cost of filling is about two dollars. By building the tank above the ground, the water can be used to flush the sewers and this saves the city of Oakdale a tidy sum each year. There is no covering over the pool, making it unecessary to heat the water, as the sun's rays accomplish that work. The pool is the principal source of amusement during the summer and keeps many people at home who would otherwise go to the seashore for their vacations.

This year dozens of similar pools are being built over California.

BEAR GRASS CREEK IMPROVEMENT

LOUISVILLE, KENTUCKY

This article is supplementary to one published some months ago on the work of the Sewer Commission in Bear Grass Creek and describes the extension of the improvement for another mile, thus removing a very disagreeable feature in an otherwise beautiful landscape in the eastern part of Louisville.

THE city of Louisville, Ky., completed, on August 17, the work of improving the channel of Beargrass creek, a stream running through the eastern section of the city, and which, in the past, caused much damage to industrial plants and residence sections. Nearly two miles of this stream has been widened, straightened and provided with concrete walls and bed. Of this, a portion almost a mile in length was improved by the sewer commission between 1911 and 1913, at a cost of $154,000. When the funds of that body were exhausted and it went out of existence, the engineering department of the city decided to continue the work. Construction was started September 22, 1913. The cost of this part of the work, which is 4,900 feet in length, was $378,847, the walls being generally higher and the excavation heavier.

The part of the creek running thru the city is known as the south fork and drains an area of about twenty square miles. The bed had filled thru deposit, causing overflows after hard rains, and to damage from this source was added that from backwater of the Ohio at high stages. Two large storm sewers entering the creek were unable to empty because of the rise in the creek-bed and these overflowed a large area. Another cause of trouble was the presence of many trestles, the bents of which were placed at an angle with the creek and stopped material carried by the water. On account of this, the creek was considered highly insanitary.

The sewer commission constructed an intercepter on each side in order to divert the run-off from a portion of the drainage area. It also brought about the condemnation of the trestles. Where necessary, these have been replaced with steel girder bridges. The removal of the deposits and the clearing away of obstructions were at first considered as means of relieving the creek, but it was decided that these would bring but temporary relief, and the building of walls and bed was then decided upon.

In the more recent construction along the creek, 650 feet of it is 50 feet wide and the remainder 40 feet. In the center is a dry-weather channel, 8 feet wide and 9 inches deep, the small size making it self-cleansing.

The walls vary in height from 9 to 21.5 feet.

The hydraulic data used in designing the improvements are as follows:

Width of section, ft.	Slope, ft. in 1,000 ft.	Small channel		Whole channel	
		veloc. ft./sec.	discharge cu. ft./sec.	veloc. ft./sec.	discharge cu. ft./sec.
40	1.4	3.05	13.7	13.90	50.70
50	0.8	2.34	14.0	10.95	51.50

The creek is designed so that when the flood discharge reaches a stage of 180 cubic feet a second, the depth at the center will be 10 feet.

The walls are built as cantilevers. Their design was complicated by the fact that the Louisville and Nashville Railroad's main line runs along the bank at a general distance of 16.5 feet from the wall, the greater part of the way on the west side, and the remainder on the east side. For this part of the way, also, the railroad has recently constructed an industrial line on the opposite side. In order to take care of the train loads, the walls adjacent have been built with buttresses, with a width of 18 inches. These are spaced 10 feet on centers, the buttress with one-half the wall slab on each side being considered as a T-beam acting as a cantilever. From the standard L. & N. engine weight, plus 50 per cent. for impact, was derived the weight per foot of rail. The angle of action of the load was assumed as 45 degrees.

Expansion joints of 6 inches are provided in the walls every 30 feet. Angle bars are used to protect the edges of the joint. The expansion joints are so arranged as to come in buttresses, those in which they occur being widened 2 feet.

All walls up to 14 feet in height are plain cantilever, while from 14 to 21.5 feet, walls carrying train loads are of buttress type.

The bed of the creek was lowered 5 feet, in addition to being cleaned of deposit. It is provided with four expansion joints in the direction of its length, while joints are placed 25 feet apart in the other direction. The sides of the joints are protected by tar-paper and pitch. The slab is 6 inches in thickness and has a troweled finish. The bed has a drop of 3 inches from the wall to the outside of the central channel. Before pouring the concrete in the bed of the creek, all holes and depressions were filled with 1:4:8 concrete.

At the beginning of construction, George Cahill, the contractor, built a dam at the southern end of the job. This extended across the stream and was provided with flood-gates. It was 6 feet high, 3 feet wide at the bottom and 2 feet at the top, and of brick on a concrete foundation. Near the middle of the job, holes were made in the Broad intercepter near the creek and siphons were constructed with two 24-inch pipes. By this means, the creek was well drained and it was kept dry by means of two Nye pumps, one being 3-inch and the other 4-inch.

Excavation was started both at the southern end and the northern end, where the creek joined the portion improved by the sewer commission. The excavating equipment consisted of one drag-line excavator built by the contractor, and two Marion steam shovels. Rock excavation ranged in depth from nothing to 5 feet, and was handled by twelve Ingersoll-Rand air drills and four Sullivan steam drills. A central air compressor was tried on one section, but electric rates caused this to be abandoned for the other sections and a team-drawn steam compressor was substituted.

The main concrete plant consisted of a 1-yard Smith mixer, mounted on a movable timber housing. This was located in the hole on a track with a 16-foot gage, this being determined by the size of the drag line. Local sand and gravel was brought in on the new industrial line of the L. & N., which was first laid far enough from the creek to permit unloading the material alongside. Planks bridged between the mixer plant and the bank and the material was carried across in wheelbarrows. The mixer house was large enough to hold a carload of cement and one of the pumps. It was also provided with a hoisting tower, the chute being supported by cables from the tower and so arranged that it could be swung around for the pouring on either side.

The central channel was poured first in order that it might

aid in carrying off the rainfall. Wherever possible the trenches for the walls were excavated by hand ahead of the main channel and the walls poured, in order that spoil from the creek-bed might be used in back-filling behind the walls. This procedure was generally an effective one, but in one case dirt that had been pushed ahead by the steam shovels for use later as back-fill became frozen, forming a dam across the stream. Heavy rains caused overflow behind this earth and it became necessary to dynamite it.

Much of the material was hauled away by railroad. A small trackage of narrow-gage road was also used.

The banks were cut to a 1½ to 1 slope. Altho the first survey of the sewer commission considered the purchase by the city of the ground that was to be cut, the consent of the property owners was secured for the work without purchase. In two cases, where the cut would have been costly to the owners, the wall was raised to a sufficient height to prevent this, the additional cost being paid for by them.

The largest change in the location of the creek was the straightening of an acute bow, where the new channel length is 900 feet. The cut at this point was 15 feet. This occurred in the city's own yards and added a large area. Several smaller fills were made in a similar way.

The quantities and unit contract cost in each class of work follows: Class A (1:2:4) concrete, plain, 3,372 cubic yards, $8.70; Class A, reinforced, 10,600 cubic yards, $10; earth excavation, 69,700 cubic yards, $1.43; rock excavation, 29,800 cubic yards, $2.53.

When property along the creek beyond the present improvement increases in value, it is expected the work will be carried further.

David H. Lyman is city engineer. Roy W. Burks, first assistant city engineer, was in general charge of the work. L. D. Lindsay was engineer for the contractor, and H. B. Campbell was superintendent.

Novel Device Prevents Washing of Maryland Roads

A novel devise is used in Maryland to prevent the washing of road shoulders and gutters. According to H. G. Shirley, Chief Engineer of the Maryland State Roads Commission, these "breakers," as they are termed, answer their purpose so well that they will pay for themselves after two or three heavy storms. They are considerably cheaper than cobble-stone gutters, give thoro protection to the shoulders of the road and may be used on any type of highway, including farm lanes and driveways.

Briefly described, the breaker consists of a low concrete barrier extending from the edge of the road diagonally thru the shoulder to the ditch. It is built flush with the surface of the road shoulder, and where highways are patrolled and shoulders kept in repair, it is no obstruction to travel. Breakers are spaced as occasion may require, and are neither expensive nor difficult to build. The Maryland breakers are 12 inches wide and 18 inches deep. As stated, spacing varies with the nature of the soil, grade, and the amount of water they encounter. Thus it would probably be necessary to space them closer at the bottom of a hill than at the top. On 5 to 6 per cent. grades and medium soil the breakers are spaced 25 to 30 feet apart. Where the soil is liable to wash and the grade is steeper, they would be spaced much closer. The length as well as the grade of a hill would also influence the spacing.

The illustration shows a macadam road with a concrete breaker extending across the shoulder of the road in the immediate foreground, while beyond appear additional breakers, the spacing in this instance being approximately 25 feet.

Local materials are usually used to build the concrete breakers. This makes the cost very low, and as the requisite materials are found in practically every section of the country, breakers could be used with economy on all types of highways. A great deal of repair work of costly nature is occasioned by torrential rains, resulting in serious washouts, and these breakers are said to reduce this work very materially. To make the shoulders of the road available for traffice their surface must always be kept in first-class repair and flush with the top of the breakers, an expense which will offset a comparatively small proportion of the saving from heavy washouts.

CONCRETE BREAKERS *as used on Maryland roads. A simple device to prevent washing of shoulders and gutters.*

LEGAL DECISIONS

Decisions of the Higher Courts of Interest to Municipalities

RIGHTS OF CONTRACTOR AND OF MORTGAGEE IN STRUCTURE ATTACHED TO REAL ESTATE.

The rights of a seller, in a contract to sell and erect a water tower on land of a corporation supplying water to become a part of its plant, which stipulates that the title shall remain in the seller until payment of the price, with right to remove on default, are superior to a mortgage executed by the corporation subsequent to the contract, but before the building of the structure, and covering not only property in existence at the time of the mortgage, but also after-acquired property, and the seller may as against the mortgagee remove the tower on default in payment of the price.

A clause in a mortgage given by a public service corporation that it shall include their acquired property is valid.

Holders of corporate bonds secured by a mortgage covering after-acquired property take after-acquired property subject to any liens or equities with which it is impressed when it comes into the hands of the corporation.—Re Frederica (Del.) Water, Light and Power Co., 93 Atl. 376.

WATER COMPANY LIABLE FOR FIRE LOSS.

Where a water works company agreed with the city to furnish a given pressure for fire protection, citizens whose property was destroyed thru fire, owing to the company's failure to furnish the required pressure, may recover against it, the contract being for their benefit.—Morton et al. v. Washington Light and Water Co. (N. C.), 84 S. E. 1019.

LIABILITY OF CITY FOR DAMAGES FOR INJURY ON CONTRACT WORK.

Where a city prepared plans and specifications for the grading of a street which called for banks at the sides of the cuts so steep as to be unsafe, but its engineer assured the contractor that they were safe, and ordered him to complete the work in accordance with the plans, and one of the banks caved in during the work, inflicting upon a workman injuries for which the contractor was compelled to pay damages, the contractor, tho liable to the workman for his failure to furnish a safe place to work, was not in pari delicto with the city, but, as to it, was entitled to rely upon the plans and the assurance of its engineers, and can therefore recover from it for the damages so paid.—Aberdeen Const. Co. v. City of Aberdeen (Wash.), 147 Pac. 2.

REMOVAL OF OBSTRUCTIONS IN STREET—REPAIR OF STREET CROSSING OVER RAILROAD.

Where the boundaries of a street have been obstructed by buildings or fences, they may, under Rev. Laws, c. 53, § 1, be removed as nuisances, unless than have continued for forty years.

Where highway under which a railroad right of way passed was narrowed, the work of restoring the highway to its original condition is a "repair," for the cost of which the railroad is solely liable under Rev. Laws, c. 111, § 132, instead of an alteration, the cost of which should, under section 134, be apportioned; a technical "alteration" being the substitution of one way for another.—N. Y. Cent. & H. R. R. Co. et al. v. Board of Commissioners of Middlesex County (Mass.), 108 N. E. 506.

CITY MUST CARE FOR SEWAGE—INDIVIDUAL NOT LIABLE FOR DAMAGE.

Tho a city may control and regulate its sewers and the character of sewage which any property owner may discharge into the sewer, and tho no property owner has a right to connect a private sewer with a city sewer without the city's consent, where a city board of health, with knowledge of the character of sewage from a distillery, ordered the person operating the distillery to make a connection with the city sewer, and he did so by the authority of the city and under the supervision of its engineering department, and the city did not by ordinance regulate the quantity or character of sewage which he was authorized to discharge into the sewer, it was thereafter the city's duty to take care of the sewage, and the distillery proprietor was not liable to riparian owners for the pollution of a stream caused by emptying such sewage into the stream.—Kraver et al. (including city of Henderson, Ky.) v. Smith, 117 S. W. 286.

WHEN LIABILITY OF SURETY ACCRUES.

A contract for the construction of a city sewer, which stipulates that the contractor and his surety will pay all damages for personal injuries growing out of the work or any obstruction on any street or sidewalk and will hold the city harmless against any damage on account of personal injury or injury to property, is a contract between the city and the contractor, and the surety is merely a surety, and where, in performance of the contract, the contractor is negligent, causing injury to a pedestrian, the surety is not liable until the negligence of the contractor has been established.

Where one sustaining a personal injury through the negligence of a city and its contractor has no right to join the surety of the contractor with the contractor and the city in an action for the injury, allowing her to do so is prejudicial to the surety because tending to induce the jury to award greater damages and because the liability of the surety is limited to the amount recovered against the city or contractor.—Owens v. Georgia Life Ins. Co. et al. (including city of Louisville, Ky.), 177 S. W. 294.

LIABILITY FOR DEFECTIVE CELLAR DOOR IN SIDEWALK.

One maintaining, without permit of a city, an obstruction in a street, maintains an absolute nuisance; but one obtaining a city permit, expressly or impliedly, and complying therewith, is not liable, and to create liability for injury

caused by the obstruction it is necessary to show failure to properly construct and maintain the same.

One maintained cellar doors extending into the sidewalk under a permit granted by the city, expressly or impliedly. The wood of the doors was and had been for a long time rotten, and the screws which fastened them had become loose. A pedestrian was injured by stepping on the doors. *Held*, that the doors were a nuisance, authorizing a recovery on that ground, tho to recover it was necessary to show negligent failure to properly maintain the doors.—Hartman v. Lowenstein et al., 154 N. Y. Supp. 205.

LIABILITY FOR DAMAGE TO BOY BY DYNAMITE CAP LEFT ON STREET CONTRACT.

Where a city of the third class was having water main trenches dug, the city authorities knowing that explosives were necessary and were being used, it was the city's duty to exercise reasonable care to avoid negligent abandonment of the explosives upon the street during the progress of the work, the duty being, not only to keep its streets fit for travel, but also to safeguard the dangerous agency, and a failure to exercise such reasonable care was negligence.

Where defendant city, because of the invalidity of its contract for street work under statute, was in contemplation of law doing the work through the contractor's servants as its own, it was chargeable with notice of the negligence of such servants in leaving dynamite exposed in the street.

Where a boy of 11 secured a dynamite cap thru the negligence of the defendant city, which, in exploding, injured plaintiff's hand so as to necessitate amputation of the first joints of the thumb and the first two fingers, a verdict for $2,750, was not so excessive as to call for reversal.—Davis v. City of Wenatchee (Wash.), 149 Pac. 337.

LIABILITY FOR DAMAGE FROM SETTLEMENT OF TRENCH.

A city maintained a series of wooden flumes to irrigate its park system. A heating company by permission laid its steam pipes under such flumes to the depth of four or five feet. The laying of the steam pipes caused the flume to sag and leak, permitting the water to percolate upon the steam pipes, causing excessive condensation. The heating company brought an action for injuries so caused. *Held*, that the injury, being the result of natural conditions, the probability of which was known to plaintiff at the time it obtained the franchise, was not actionable.—Yakima Central Heating Co. v. City of North Yakima (Wash.), 149 Pac.

DISQUALIFIED FOR OTHER OFFICE BY VOTING ON HIS OWN RESIGNATION AS COUNCILMAN.

Under Act March 31, 1860 (P. L. 382), prohibiting any councilmen from being at the same time any other officer who shall receive a salary, a councilman was disqualified from holding the office of water superintendent of a borough, tho he had resigned from the council, where he voted for the resolution accepting his resignation; such resolution being ineffective by reason of his illegal vote, and he being still a de jure member of the council.—Commonwealth (Pa. ex rel. Whitehouse, Dist. Atty. (Ashland Boro.) v. Randenbush, 94 Atl. 555.

CONTRACTOR'S SURETY LIABLE FOR SUPPLIES BUT NOT FOR EQUIPMENT.

Rubber goods, consisting of hose, washers, couplings, spanners, belts, tubing, packing, gloves, boots, overcoats, furnished to a contractor erecting a public vertical lift steel bridge, are "equipment," within the rule that contractor's bond, conditioned as required by Rem. & Bal. Code, § 1159, on the payment by the contractor for provisions and supplies for carrying on of the work, does not cover the cost of the contractor's working "equipment," and the surety is not liable therefor, since the word "equipment" imports the outfit necessary to enable the contractor to perform the agreed service, and the word "materials" includes such articles only as enter into and form a part of the finished structure, and the word "provisions" is used in its ordinary meaning, and the word "supplies" includes any article furnished for carrying on the work which from its nature is necessarily "consumed" by use in the work, that is entirely worn out or destroyed by use, though the goods furnished the contractor were actually worn out by use in carrying on the work, but would have survived had their use been of less duration.—U. S. Rubber Co. of California v. Washington Engineering Co., 149 Pac. 706.

SUFFICIENCY OF DESCRIPTION OF WORK UNDER CONTRACT.

An ordinance for the construction of aseptic tanks as part of a city sewer system, which provides that the tanks shall have a sufficient capacity to purify the usual dry weather flow for a population of 1,500 people, that the sewage delivered to the tanks shall be purified to the extent of 90 per cent. of solids, that the effluent discharge be not putrescible, and be free from color or odor, and that the tanks should be built in such manner and of such material as to be satisfactory in point of strength to the city engineer, sufficiently stipulated the character of the tanks, within Rev. St. 1909, § 9384, and the provision committing to the engineer the matter of material and strength is at most an irregularity, not sufficient to render a contract for the construction of the tanks, in accordance with the ordinance, void.—Schueler v. City of Kirkwood (Mo.), 177 S. W. 760.

DIVERSION OF SPECIAL FUND NOT BAR TO RECOVERY FROM CITY BY CONTRACTOR.

Where a contractor performs services for a city under an ordinance or contract, stipulating that his compensation shall be from a special fund to be raised therefor, and the fund, when accumulated, is diverted by the city to another purpose, the diversion is a breach of trust, and the contractor may enforce his claim against the general revenue of the city, tho the fund raised by taxes was raised under an ordinance subsequently declared unconstitutional, since taxes voluntarily paid may not be recovered, tho paid under a void levy.—Idem.

LEGALITY OF STREET ASSESSMENT ON RAILROAD PROPERTY.

There is a fair presumption that all real estate receives some degree of benefit from the permanent improvement of a street upon which it abuts, and when a city council, acting in accordance with the statute, orders the paving of a street, and provides that the cost shall be assessed upon the abutting property, this is a legislative determination that the improvement is expedient and proper, and that the property abutting on the improvement will be benefited thereby, and such determination cannot be set aside or overruled in a judicial proceeding; and hence, while a property owner may have the regularity of the procedure by the council and the equality of the assessment reviewed, he cannot be heard to say that the property is not liable to be assessed at all.

To support an assessment against abutting property for the cost of a street improvement, the city need not be able to show that by reason of the improvement the abutting property has been advanced in market value to the extent of the assessment, nor point out in detail the specific way and manner in which the requisite benefits are to be realized, as the benefits ordinarily materialize with the developments of the future, but they are none the less benefits because their full fruition is postponed, or because the present use to which the property is devoted is not of a character to be materially affected by the improvement.

The law permitting the expense of a public improvement to be laid upon all abutting property in proportion to benefits does not limit its inquiry merely to the land as related to

its present use, but, while not disregarding such use, it does not overlook its general relations apart from its particular use.

A railroad right of way 100 feet deep for 800 feet bordered on a street in the platted portion of a city of from 7,000 to 9,000 inhabitants. It was occupied and used for railway purposes, and was within convenient distance of other railways. The paving of the street improved its usefulness and convenience as a means of travel and transportation in that neighborhood, and facilitated approach and access to the company's station and warehouses. On an appeal from an assessment of benefits, the company, to show a lack of benefits to the right of way from the paving, introduced testimony of engineers and railway employes describing the outlines and topography of the right of way, and the manner in which it was occupied by the tracks; such witnesses also expressing the opinion that the street paving added nothing to the convenience or value of the railroad, or of the business thereof. *Held*, that, assuming that the question whether the property received any benefits was open to judicial inquiry, the company did not sustain the burden of showing that the property was not benefited, in view of the presumption that all abutting property derives some benefit from the improvement of a street, and also in view of the prima facie correctness of the assessment.

In view of the presumption that all abutting property derives some benefit from the improvement of an abutting street, and also in view of the prima facie correctness of an assessment of benefits by the city council, the burden of negativing such benefit on an appeal from an assessment of benefits is upon the property owner assuming that the question is open to judicial inquiry.—Chicago, R. I. & P. Ry. Co. v. City of Centerville (Iowa), 153 N. W. 106.

DAMAGES FOR CHANGE OF GRADE OF HIGHWAY.

Special benefits may be set off against special damages sustained by an abutting owner, which have accrued by reason of a change in the grade of a highway.

In awarding special damages for a change in the street grade, the measure of damages is the difference between the actual market value of the property before the change and such value after the change is completed, taking into consideration everything likely to affect such value.

A city may, in repairing highways or sidewalks, raise or lower the grade, widen the traveled path, and remove earth and trees interfering with the use thereof.

Damages caused by the change of street grade are recoverable only as actually cause; possible future damages from future changes not being recoverable.

Damages are recoverable for a change of street grade affecting only part of the highway, leaving the rest unchanged.

An abutting owner being presumed to own the land in a highway in front of her property, such owner need not remove steps leading to the sidewalk, where they do not obstruct public travel, tho they are within the highway limits.

In changing the grade of a street, an abutting owner may recover no damages for removal of steps leading to the sidewalk, altho within the highway limits, until such removal is actually accomplished.

Since an abutting landowner who maintains steps in the highway without objection for many years acquires no right to so maintain them, such owner may be obliged to remove them at his own expense if they become, by change of street grade or otherwise, an obstruction to public travel.

A change of grade of part of a highway, leaving a bank of earth between the property line and the outer edge of the newly established grade, does not, in law, constitute a "change of grade" of the entire highway.—Rogers v. City of New London (Conn.), 9. Atl. 364.

United States Court Holds Cameron Septic Process Patent Still in Force

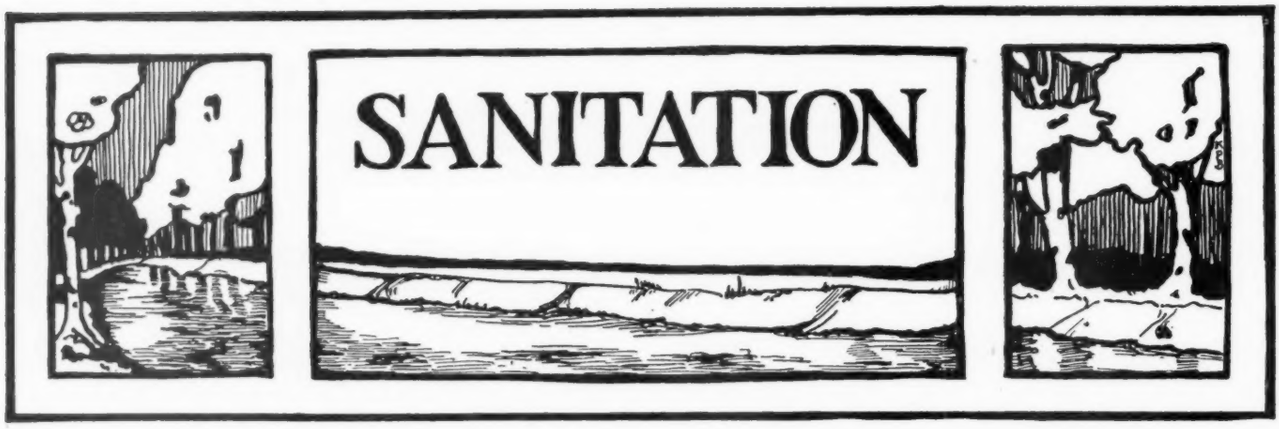
By H. D. Wyllie, Chicago, Ill.

The United States Court, by an order entered at Richmond, Kentucky, on September 18, 1915, has sustained the Cameron Septic Tank Company in its insistence that the Cameron septic process patents (634423) is still in force. The defendant was the city of Winchester, which had plead that the patent expired in this country when the Cameron British letters patents expired some years ago, asserting that such foreign; and the court has so held, disallowing the de-American patent sued upon. The court holds that this assertion of identity was not true in fact, and so the expiration of such foreign rights had no effect whatever here, and the process claims of the American patent have not expired. The Cameron Company showed that the foreign letters patent were for apparatus while the American claims sued upon were for process and were not of the same scope as the foreign; and the courst has so held, disallowing the defendant's plea. The Cameron septic process claims remain in full force.

Some users of the septic process seem to have had a misapprehension of the circumstance that in another suit, against the city of Knoxville, Iowa, the United States Supreme Court decided that under the record in that suit the American patent must be held to have expired with the British letters patent. But in that suit the question as to the actual identity of the patents was not in issue. On the contrary, as the Cameron Company has repeatedly made clear in its published statements, for the purposes of that Knoxville suit only it had been stipulated by the counsel that the assertion of identity might be taken as true, in order to expedite an appeal to the Supreme Court on a question of mere law as to whether, even if such asserted identity were a fact, the American patent would still be in force in view of a certain treaty. The Supreme Court merely held that the treaty did not have such effect. And in the present Kentucky case the court followed that holding as to the treaty, but has found as a fact that the Cameron septic process claims are not for the same invention as the foreign letters patent, so that the treaty question is without application. It was simply a situation in which the Cameron Company had two remedies, either sufficient in itself—one was overruled but the other is now sustained. The previous decision was a merely negative one benefiting only the particular defendant in that case, the city of Knoxville, Iowa. The present decision is an affirmative ruling that the claims are still in force, and is based on an actual comparison of the American and foreign patents that have never previously been before any court for such comparison at all.

The claims thus established to be still in force are all of the process claims, Nos. 1, 2, 3, 4 and 21, of this Cameron septic process patent (634423), and are the same claims whose validity was established some years ago by the United States Court of Appeals. That decision that the claims were valid has needed, to make it fully effective, a decision that the claims would also remain in force for the full seventeen years' term of a normal United States patent—and such decision has now been made. The patent has been thru long years of litigation to reach this ultimate success, and has been thru much controversy with the users of the septic process for sewage disposal, many of whom, however, have acknowledged it and paid the reasonable license fee that the Cameron Company has asked for the use of the process.

The type of septic tank used by the city of Winchester, the defendant in this Kentucky case, is that known as the "Imhoff," or what has been aptly called by Mr. George W. Fuller in his recent treatise on "Sewage Disposal," a "two-story" septic tank.



Improvement of Quequechan River in Fall River, Mass.

The report of the Watuppa Ponds and Quequechan River Commission, on their improvement in the city of Fall River, Mass., was recently transmitted by the Commission to the City Council and has been referred back for further consideration of certain portions. The report contains the solution to a number of the difficulties under which the city labors and the long-talked-of improvement of the Quequechan is set forth for the first time in complete figures of ultimate cost.

The engineers estimate the cost of constructing the improvements required at the present time at $2,600,000. This amount includes not only the cost of building the required conduits and their connections and controlling apparatus, but also the cost of a system of sewers and drains for the Quequechan valley which are needed in any event, as well as the cost of filling the entire area of the Quequechan flats. This figure does not include the items of damages and general expenses, which it is estimated will be offset twice over by the value of the filled flats remaining in the possession of the city when the improvement is completed. As a further reduction, a part of the expense is assessable upon interests specially benefited by the undertaking, and the estimated net expense to the city for the works to be built at this time is less than $1,125,000.

The Commission was created by the Mayor and City Council in accordance with the Acts of 1913, Chapter 767. Its first prescribed duty is that of investigation and the making of a report, and the prescribed fields of these are the nuisances of the Quequechan, the control and direction of the waters of the stream, the planning for sewers and surface water drains, and the needs of the city for the increase, purification, protection and control of its domestic water supply.

To assist it in carrying out the duties required by law, the Commission retained for consulting engineers the firm of Fay, Spofford and Thorndike, of Boston. The reports of the Commission contains its own outline of the situation and its remedy, together with the report of the engineers.

For years the city and the mills have allowed the Quequechan River, which runs thru the center of the city, to decline to such a condition that the mills can make only partial use of the river and of the great storage capacity of the ponds about, while the river itself has been polluted to such an extent that it is a nuisance and menace to the welfare of the whole community. In fact the abatement of this nuisance is one of the most pressing problems in sanitation in Massachusetts today.

With the magnificent water power available, and with the subsequent development of steam power, industries almost exclusively textile began to be located along the banks of the river, using the water from the river for boilers, condensers, and industrial purposes. These industries have continued to increase in number and size until today most of the available sites are occupied, while a considerable area of the low land bordering the stream has been overflowed. A few sewers have been provided to care for these mills, and in general their sewage is discharged directly into the Quequechan, or reaches it thru the overflow of cesspools, in either case polluting the stream.

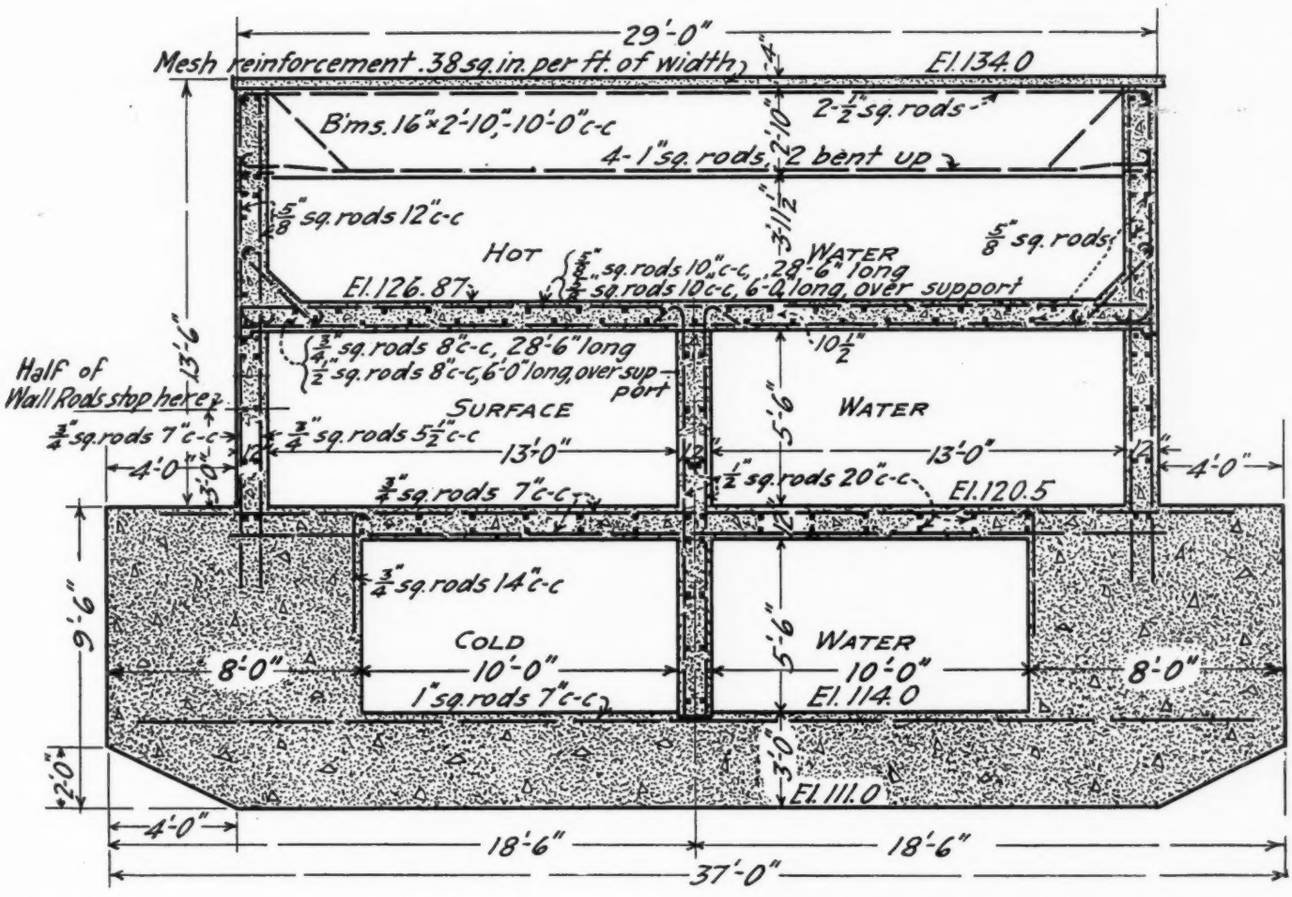
After the building of the Watuppa dam on the Quequechan river the overflowed flats of the Quequechan became a shallow basin thru which the current flowed slowly, and much of the street wash, with sewage and mill wastes, have formed a bed of sludge which has obliterated the original channel to such a level that the Watuppa Ponds can no longer be drawn down to the point possible when the dam was built. This bed of rich sludge stimulates a rank growth of vegetation, and when uncovered frequently gives forth offensive odors. The condition is made worse by the heating of the water by discharges from mill condensers.

Whatever may be the plannings for improvement along the Quequechan, they must first of all meet with the approval of the State Department of Health, for this is a requirement of the Act creating the Commission. In the first place, all sewage must be kept out of the stream. This means not only discontinuing the storm overflows already referred to, but that sewers must be furnished for the mills in those parts of the district where they are now not provided. A second condition is that the storm water falling on the slopes of the Quequechan river valley must be kept out of the Watuppa ponds. A third condition is that the existing nuisances along the Quequechan must be abated. Lastly, means must be taken to guard against the danger of floods in the south Watuppa pond, a danger that will be increased when the intercepting drain on the west shore of the north pond is completed.

The plan presented by Fay, Spofford & Thorndike in their report, propose to provide for the improvement of the water supply to the mills, for the complete utilization of all the water available by development of the storage capacity of the south pond, and for the abatement of the nuisances of the Quequechan.

First, there is provided a feature unique in engineering, a three-story waterway or conduit shown in the accompanying illustration. It will be really three channels in concrete, placed for convenience and economy in space and costs, one above another. One channel, the lowest, will supply an adequate quantity of clean, cold water to the mills, both above and below the Watuppa dam. The second canal, the top one, will carry the hot water from the mill condensers back to the south pond where it will be cooled and be available for use again in the cold water supply to the mills. Here is great economy of water.

The third channel, the middle one, will take the surface drainage of the slopes between the Sand Bar and the Watuppa dam, and will serve the fourth function of being an emer-



gency channel for the overflow of the south pond in times of flood.

The second feature of the plans is the provision of a system of drains for the surface water to afford relief to the existing overtaxed sewers.

The third feature is the construction of new sewers to carry away the sewage and wastes from the mills and other buildings along the valley of the Quequechan, which now pollute the stream.

The fourth feature is the construction of an outfall sewer from the vicinity of the Watuppa dam to tide water, a sewer which will be large enough to take both the sewage and the storm flow of the Quequechan valley.

The fifth proposition is to fill the entire area of the flats above the Watuppa dam. This will not only abolish the nuisances existing, but will make available for factory sites a large tract of land, the value of which when improved will offset in part the cost of the larger proposed improvements.

The solution of certain sewer and drain problems inevitably accompanies any plan for abolishing the Quequechan nuisances. The existing sewers, tho not built for the purpose, are now used to take both sewage and storm water, and it has been necessary to give them relief openings into the Quequechan thru which the storm water and sewage may be discharged in times of heavy flow. This has been one cause of the pollution of the stream. To avoid it, it is necessary to keep the storm water and sewage separate by building a separate system of drains for the former. The sewers will then be adequate for their special functions, and the relief outlets can be closed.

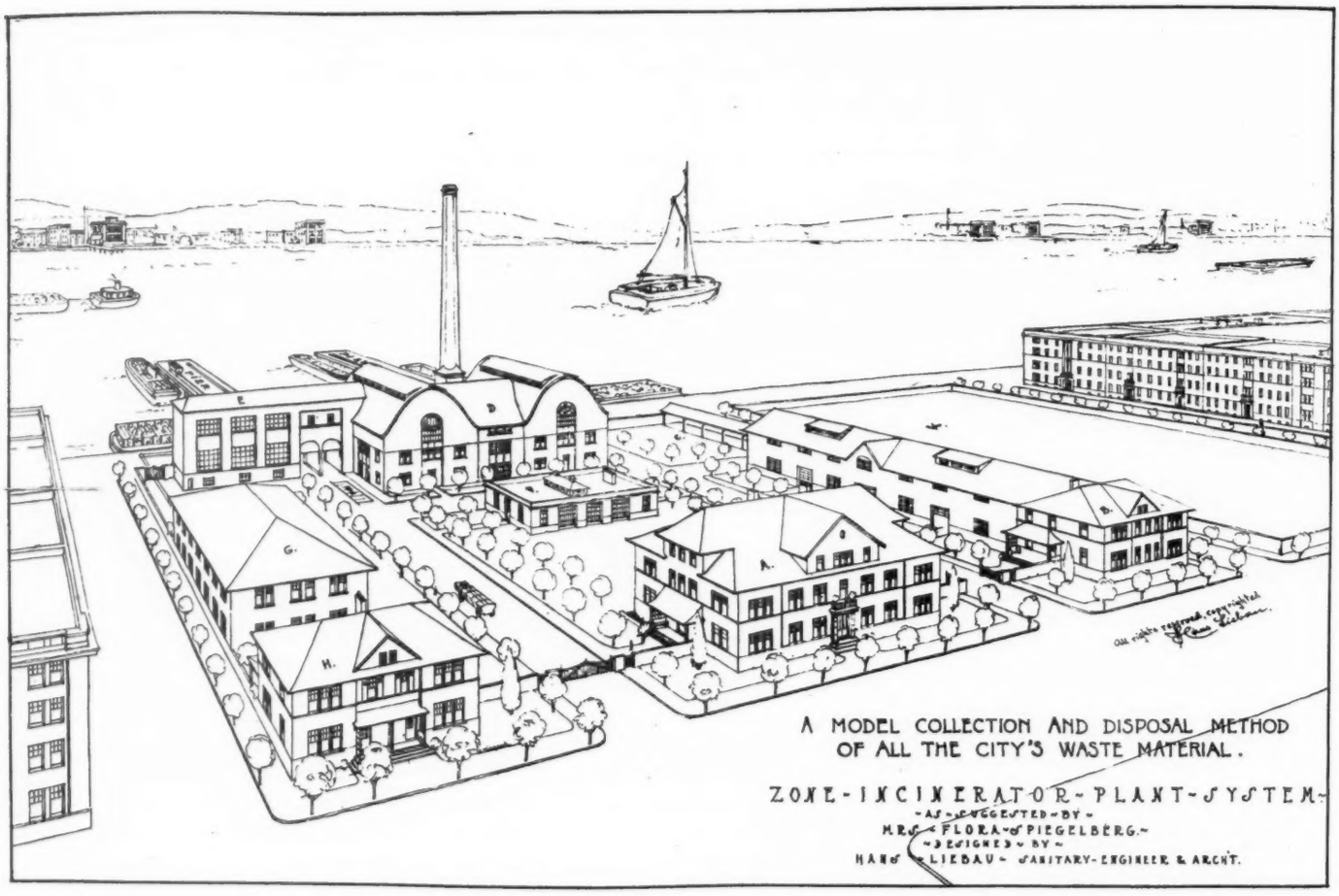
The study of the sewer system as presented in the report of the engineers is more comprehensive than at first intended, for it was found that the whole district was involved. The entire sewer system provisionally designed and shown by the plans of the engineers will be some sixty miles in length, but only five miles need be built at the outset. A program for construction is outlined for the engineers. In designing the conduit allowance has been made for future business growth of Fall River. Increase in the needs of the existing mills is figured, and it is assumed that the number of mills along the stream will be doubled, new sites being furnished by filling flats.

The report on the project has had brief consideration by the Fall River City Council, under the Act under which the investigation and report were made, which calls for positive action on it within thirty days after its receipt. In order that all parties interested may have further time for the consideration of the matter, the City Council has voted to refer the report back to the Commission for further study, and final action will not be taken for perhaps two or three months. In any case, the work is not likely to reach the construction stage until next spring.

Collection and Disposal of City Wastes

A public-spirited citizen of New York City, Mrs. Flora Spiegelberg, has entered the campaign for better methods of collection and disposal of the city wastes which cannot be carried off thru the sewers by the water-carriage system. Our American cities are backward in this matter, largely because the people have not recognized the necessities of the case. They admit the nuisance of their garbage pails and refuse heaps as well as ash piles, but do not demand from the municipal officials that method of removal be put in operation which will eliminate these nuisances.

The campaigns against the fly and of late against the rat have opened the eyes of many, and larger expenditures necessary for adequate treatment of the problems will be demanded



by the taxpayers rather than discouraged. If other influential citizens will follow Mrs. Spiegelberg's example in their own communities, most of the present complaints will soon be remedied.

One of Mrs. Spiegelberg's plans involves the zone system of collection and disposal, some approach to which in St. Louis was described recently in MUNICIPAL ENGINEERING. From an article prepared by her, abstracts are taken to show the good features of the plan.

The mixed collection of ashes and garbage is recommended, eliminating the common breeders of flies and disease, and sustainers of rats, such as covered and uncovered dumps, scows, dumping piers and substituting the dustless, odorless and flyless mixed collection due to the presence of ashes in the mixture.

Incineration of the collection is shown by reference to foreign plants to result in power for other purposes than those of the plant itself. Thus the excess power in the plant at Rotterdam supplies the electric railway system of the city and the further excess it is proposed to use for charging motor trucks. At Frankfurt, however, the combustible matter in the collection was so low that oils and grease collected from the sewage disposal works on the same grounds have to be burned in the incinerator to make it self-supporting.

American refuse is estimated to contain more combustible material than foreign, both in the waste lumber, bedding, paper ,etc., and in the garbage, so that incinerators in America should do fully as well as in Europe, if not better.

Application of surplus power is recommended to such uses as charging of storage batteries for motor cars of the collection and street cleaning departments and cars and trucks of other city departments.

In New York the refuse destructors would be located along the river, one for each zone, the sizes of zones being carefully selected for the most economical handling of material. Covered wagons, from which odors cannot escape nor into which flies cannot enter, even while dumping from garbage cans into wagons, are used in European towns. The Ochsner system, in use in Fuerth, which is noted for an effiicient system of collection and incineration, is commended. Illustrated descriptions of some of the German designs for such collecting wagons have been published in MUNICIPAL ENGINEERING.

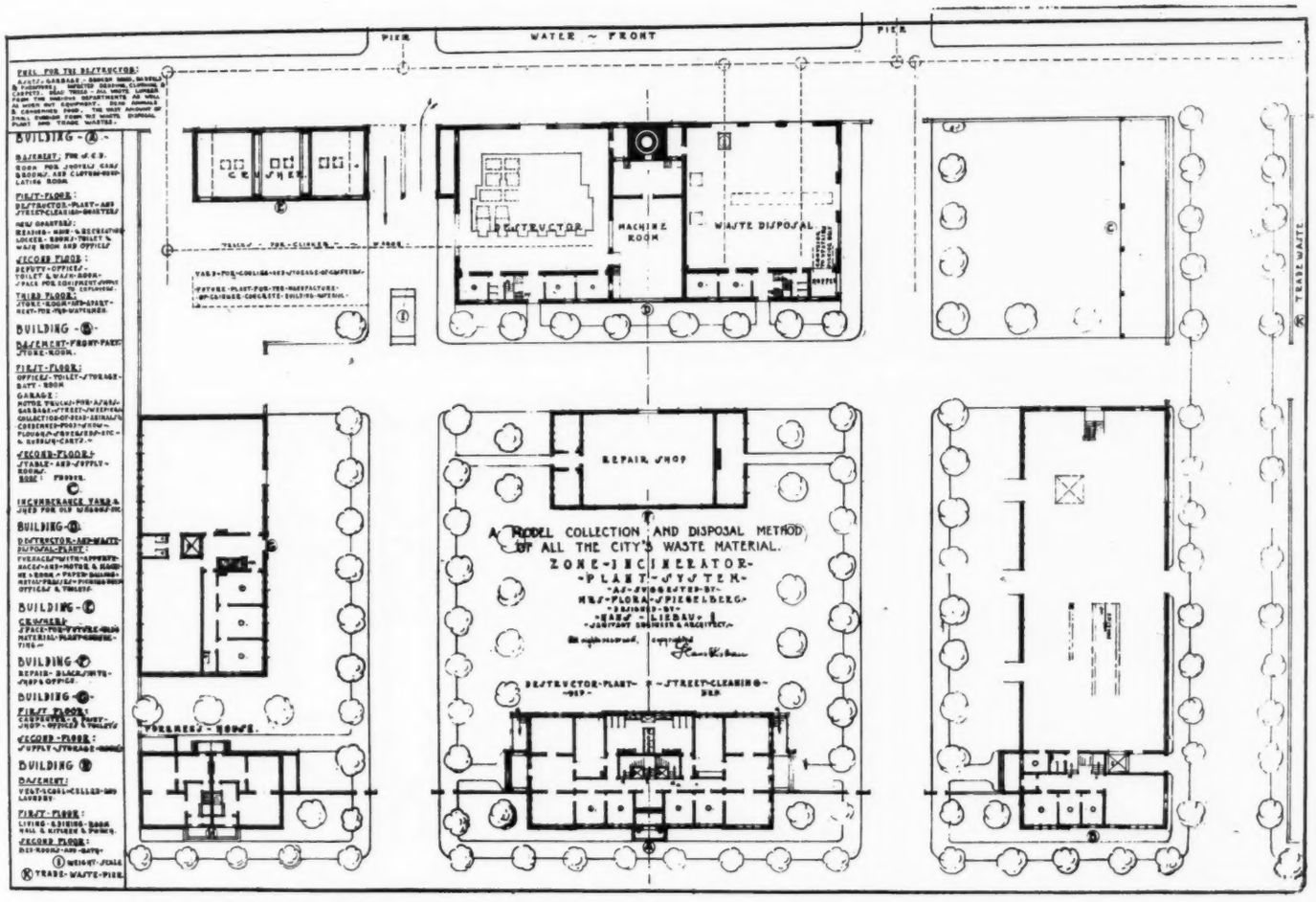
The holding scows for receiving garbage along the New York river front is particularly condemned, in contrast with the dumping of the contents of such completely protected wagons directly into the furnaces at incinerators. The present methods of collection and disposal of dead animals is as unsanitary as the handling of garbage.

A model district for the exposition of the best methods of garbage and refuse collection and street cleaning has been designed and proposed for New York and the addition of the incinerator is recommended that the foreign results may be compared with results under favorable conditions in this country, so that the deductions from foreign practice regarding possible results in this country may be tested.

Proper disposal is as essential as proper collection, and incineration will be the most sanitary if scientifically operated. operated.

Hans Liebau, sanitary engineer and architect, has made a general plan for the incinerator plant of a zone which includes the following buildings, shown in the perspective drawing on this page and the plan on the following page:

A. *Basement:* Street cleaning department room for shovels, cans, brooms and clothes ventilating room. *First Floor:*



Destructor plant and street cleaning quarters; men's quarters, including reading, main and recreation, locker, toilet and wash rooms and offices. *Second Floor:* Deputy offices, toilet and wash room, space for equipment supply to employes. *Third Floor:* Store room and apartment for the watchmen.

B. *Basement:* Store room. *First Floor:* Offices, toilet, storage and battery rooms; garage with motor trucks for ashes and garbage, street sweepings, collection of dead animals, condemned food, snow plows, squeegees, rubbish carts, etc. *Second Floor:* Stable and supply rooms. *Roof:* Fodder.

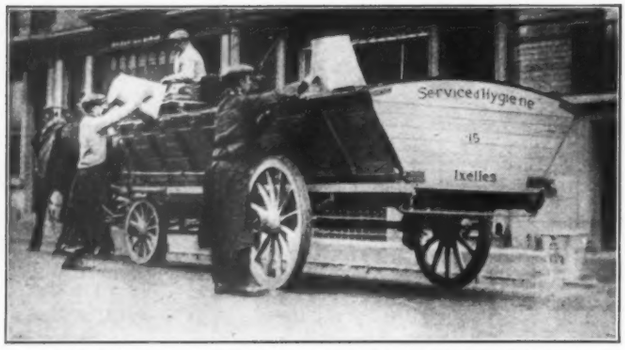
C. Incumbrance yard and shed for old wagons, etc.

Sanitary Wagons for Collecting Municipal Refuse

For the sanitary collection of refuse there must be suitable receptacles in which the householder deposits his rubbish and wagons so designed that the receptacles can be discharged into them without raising the dust or distributing odors, and the wagons can be drawn thru the streets without distributing odors or being open to the wind so that light articles, including dust, can be blown about. The accompanying illustrations show wagons and refuse cans used in Rorshach, Switzerland, which apparently meet the requirements. The wagons have the additional advantages that the cans can be emptied into them quickly and they can be emptied almost instantly. The space for the rubbish is as large as possible, the appearance of the wagon is good, and it is of the proper height so that a man on the ground can empty a can into it without assistance. The cans must not be too large for one man to lift. Two sizes are shown in the photographs, the larger one being used for light refuse. Covers of cans and of sections of the wagon are so designed that they open and close together so that the contents of the can are not exposed to view or to the wind during the process of emptying the can.

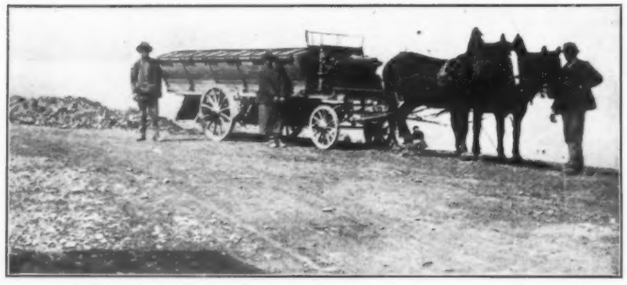
The first photograph shows one of the steel wagons of the Ochsner system, used in Rorschach, drawn by a motor, taking the refuse from a series of apartment houses. The cans of the system, large and small, are seen stacked on each side of each doorway, and in the foreground a man is picking up a full can at the door and another is emptying a can into the wagon. The complete connection between can and wagon during the process of emptying is clearly shown.

SANITARY REFUSE COLLECTION *wagon of steel, propelled by motor, as used in Rorschach. Note that the sanitary receptacle is emptied into the wagon without contact with outer air.*



SANITARY REFUSE COLLECTION WAGON *of wood as used in Ixelles.*

The second photograph shows a wooden wagon of the same system, drawn by horses, the cans at the curb and the process of emptying them into the wagon, the entire freedom from dust and odor being evident.



DUMPING *feature of sanitary refuse collection wagon is shown in this photograph.*

The third photograph shows the wagon at the dump. It will be noted that there are six gates in the bottom of the wagon, which close against sills running across the bottom of the bed. The wagon has just dumped the load seen at the left, by dropping the gates, which, by swinging back, permit the wagon to move forward, trailing the gates over the top of the pile until all the load is shaken out. Then the gates are drawn back into place, closing the bottom, by turning the crank at the front of the body, as shown in the picture.

The system was invented by A. Ochsner, of Zurich, Switzerland, and has been thoroly tested by about five years of use, with improvements made from time to time as experience showed their desirability.

The system is in use in more than twenty-five Swiss cities, including Bern, Geneva, Zurich, etc.; in Furth and Altona, Germany; in Czernowitz and Agram, Austria; in thirty French cities, including Boulogne, Lyon, Verdun, etc.; in Ixelles, Belgium; in Palermo, Italy; in Alexandria, Egypt.

It is understood that the system will be introduced in the United States by Mr. Ochsner. It will serve a purpose which has not yet had proper attention in this country.

Treatment of Sewage with Electricity and Lime

The electro-chemical method of sewage purification, as applied at the Elmhurst sewage disposal plant in the boro of

The process of sewage treatment used involves four steps: screening, electrolytic treatment with the addition of lime, sedimentation, and filter pressing of sludge. All four stages are in use singly or in various combinations, but this is the only plant in which the treatment of sewage by electricity is combined with any of the others. The first, third and fourth stages are common to many methods of sewage treatment and the unique features of the plant are in the combination of electric treatment and lime in the second stage. Reference may be made to MUNICIPAL ENGINEERING for October, 1914, vol. xlvii, p. 279, for a rather detailed statement of the principles involved in the process and the methods and results of operating the first small plant. It will then be sufficient to present here the results of the operation of the present larger plant and the estimates of the engineers regarding the operation of the plant under ordinary commercial conditions.

Careful experiments showed the board that the best results Queens, New York City, was described and the results of operation were given in MUNICIPAL ENGINEERING last year. The plant concerning which that report was made was one with a maximum capacity of 25,000 gallons a day.

As a result of the favorable results in the small plant, one with a capacity of about 1,000,000 gallons a day was installed and has been in operation since March, 1915.

During April, May and June, 1915, this new plant was operated under the general supervision of a board of four members, composed of Prof. W. P. Mason, Dr. J. C. Olsen and Dr. C. O. Mailloux, together with P. M. Travis, the chemist of the boro of Queens, who also made inspections of other plants using one or more of the processes which are combined in the Elmhurst plant. They have made a report of their observations, analyses, experiments, computations and conclusions, under date of August 2, 1915, which has been published, together with a report by Martin F. Cody, the boro engineer in charge of the plant, of its operation during the months of June, July and August, under date of August 26, 1915, by the Electro-Chemico Corporation of New York.

were obtained by treating the screened sewage by electricity at the rate of about 85 kilowatt hours for a plant of 1,000,000 gallons capacity per day, and then mixing with it 1,300 pounds of hydrated lime per million gallons, followed by sedimentation, the resulting sludge to be reduced to manageable form by filter pressing. This greatly improves the effluent over the original sewage, rendering it non-putrescent, reducing color from 47 to 19 parts per million and turbidity from 41 to 7. The reduction in objectionable bacteria, as well as in food for putrescent processes, is indicated by the satisfactory character of the effluent.

The Elmhurst sewage is more diluted than that at Worcester, Mass., but is stronger than the average of sewage from seven Massachusetts cities.

Lime alone produces similar results, when used in large quantities, 30 grains per gallon at Worcester requiring sedimentation period of 4 to 8 hours, and 200 grains requiring a half hour, whereas at Elmhurst but 7½ to 9½ grains of lime per gallon were used, combined with the electrolytic action. The advantage of the electric action seems to be in reducing the time required for sedimentation and in greatly reducing the quantity of lime required. The chemical condition of the effluent is also different. The board thinks this is because nascent oxygen is formed in the electrolyzing process, the theoretical amount being about 2 c.c. per liter, which oxidizes organic matter. There seems also to be an agglutination of colloidal particles as a consequence of the action of the electric current.

The result of the operation of the electric current is different from that of the application of hypochlorites to sewage or water, and leads the board to believe that the beneficial results are not due to the setting free of chlorine by the electro-chemical actions. The best results were obtained when the lime

was added after the sewage had passed beyond the action of the electric current.

The sludge produced by the electro-chemical process is about the same as that produced by the lime process, but whereas the lime sludge has a relative stability rating of about 50 per cent., according to the standard methods of American Public Health Association, the sludge from the electricity and lime process has a stability rating of 95 per cent. or more.

The sludge is a practically odorless brownish mass, which can be used for filling, for top dressing of soil or any other purpose for which it is suitable, without nuisance of any sort.

The cost of operating the old septic tanks at Elmhurst was about $65 per million gallons of sewage. The cost of the electrolytic method is estimated at $22.28 per million gallons. The estimate is made up in detail from figures of current used and labor at the Elmhurst plant and estimates from other plants on sludge disposal, and is as follows for a 1,000,000-gallon unit:

Lime, 1,300 lbs. at $7.90 a ton	$5.14
Electricity at 4 cents a kw.-hr—	
For electrolysis, 85 kw.-hr	3.40
For agitation, 60 kw.-hr	2.40
For lime vat, 16 kw.-hr	.64
Sludge pressing and removal	5.11
Labor and supervision—	
Superintendent, $150 a mo.	
Junior chemist, 75 a mo.	
Two laborers, 150 a mo	12.50
Maintenance and supplies (Mainly replacing of electrodes.)	1.00
Total	$30.19
Pumping, 174 kw.-hr	$ 6.96

The overhead and labor charges being nearly the same for a 3,000,000-gal. plant, the cost per million gallons for a plant of that capacity is estimated at $22.28

Economies introduced into the plant since the board's report are shown in the boro engineer's report and show less cost for each item of electricity used and in amount of lime used. The saving in current seems to amount to about $3 a million gallons and the saving in lime to about 75 cents.

A supplementary manuscript report by the boro engineer, dated October 4, calls attention to the unsatisfactory method for the disposal of sludge under the old septic system, when five laborers were employed every working day of the year to dispose of not more than 30 per cent. of the sludge. Pipes were installed in August and September, by means of which all the sludge is disposed of without the aid of any laborers. This means a saving for the city of $3,900 per year, the amount which went to pay the five laborers.

As to the amount of lime and electricity used, they remain about the same as stated in the boro engineer's report of last August. Thus, for the week ending August 21, the amount of sewage treated by the electrolytic system was 5,678,000 gallons, at a cost per million gallons:

Lime, 1,092 pounds, at $10.50 per ton	$ 5.73
Electricity, 106 kw. hr., at 4c	4.32
Total cost per million gallons of sewage	$10.05

For the seven days of the week ending October 2, amount of sewage treated, 5,400,000, at a cost per million gallons:

Lime, 1,037 pounds, at $10.50 per ton	$ 5.44
Electricity, 105.5 kw. hr., at 4c	4.22
Total cost per million gallons of sewage treated	$ 9.66

The electrical cost can be reduced by having the lime tanks made somewhat larger and so placed that the milk of lime can be supplies to the machine by gravity, by this means dispensing with the motor which is used for driving the lime pump.

Report of an analysis by Mr. Travis of a sample of sludge taken from electrolytic process plant, October 8, 1915, showed the following results:

Total solids	5.93	per cent.
Volatile and combustible matter	19.74	per cent.
Carbonate of lime	36.74	per cent.
Free ammonia	(1033 p.p.m.) 0.1033	per cent.
Organic nitrogen	(8332 p.p.m.) 0.8332	per cent.

The putrescibility tests showed that with 2 grams of sludge there was no indication of putrescence after four days.

The above tests go to indicate that the sludge obtained from this process is stable and non-putrescible.

Plans for Garbage and Refuse Disposal in San Francisco

Having rejected the garbage destructor recently erected and tested San Francisco, notwithstanding a suit seeking to compel the city to accept the destructor as practically complying with the contract, is asking for propositions from others for disposal of garbage and refuse.

E. G. Borden offered an experimental Heslewood 50-ton hydro-incinerator, which is a modified gas producer and would cost $8,650; if successful the city to pay for it and $50,000 for the use of the patent in the construction of as many plants as it may find necessary.

J. E. Briggs proposed to build Decarie incinerators.

Collins & Pellett proposed to build 512-ton incinerators, guaranteed odorless and practically smokeless for $340,000.

J. B. Harris of Nashville, Tenn., made a bid on his municipal garbage destructor and steam generator.

Dr. J. M. Hirsch of Chicago, Ill., presented his chemical treatment plant producing valuable fertilizers.

T. J. Lacey of San Antonio, Tex., presented E. L. Culver's method of making fuel briquets of garbage.

Fred T. Smith made several offers, from one offering to reconstruct the city's old Thackeray incinerator for $85,000 and operate it for ten years at 60 cents a ton, with 500 tons minimum a day, to one offering a new plant of his own design, costing $510,000 for capacity of 720 tons in 16 hours without dust, smoke or odor sufficient to cause nuisance.

Charles Turner presented for the San Francisco Disposal Company a separate collection, refuse to be incinerated in the rejected plant and garbage to be reduced in the company's present plant enlarged as may be necessary to meet the city's growing requirements.

Richard Schmidt offered to take care of all garbage and refuse at 60 cents a ton under a 35-year franchise. He would use the system of dumping and covering the refuse with earth, with such chemical treatment as may be necessary according to the method, which has been in use in Seattle, Wash., for some months, offering a return to the city of 3 cents a ton for the first year and 4 cents thereafter on all garbage disposed of, whatever its source. This offer seems to have impressed City Engineer O'Shaugnessy, who recommends a thoro test of the method before entering into a contract.

LIGHTING

New Designs for Street Lighting Units

At the present time more attention is being paid to street lighting and its problems than ever before. Municipalities are beginning to realize that good street lighting means a better, cleaner city, enhanced property values and civic progress. It is good business to have well lighted streets, good business for the merchants and property owners, good business for the city as a whole.

This growth of interest has been paralleled by activity on the part of the manufacturers, and wonderful advances have been made in both the development and application of street lighting units. Among the most recent is the development of the new high-candle-power sizes of series lamps. These lamps have efficiencies which were never before thought possible and make high-candle-power incandescent lamp units practical. The filament is a closely wound coil of drawn tungsten wire of great strength, but instead of operating in a vacuum, it operates in an atmosphere of gas. This enables the filament to be run at very high temperature without decreasing the life.

Due to the high temperature of the bulb, it is desirable to operate all lamps rated 400-c.p. or over in ventilated fixtures equipped with globes to protect the lamp bulb from the effects of moisture and atmospheric changes. Furthermore, the extreme concentration of the filament produces high intrinsic brilliancy and consequent glare unless globes of diffusing glass are used to conceal the light source and improve the distribution. Even on the smaller sizes where a globe is not required for protection, some such device is recommended for diffusing the light and removing the filament from the line of vision.

PENDENT *street lighting unit equipped with reflector and prismatic refractor.*

The fixtures shown in the accompanying cuts are the latest designed for the operation of the high-candle-power Mazda C lamps, and they embody the very latest ideas in design, both of an artistic and mechanical nature. These units have excellent light distributing characteristics, giving the maximum light at the 10-degree angle, which is the best for effective street lighting.

Thy are made for use with 5.5, 6.6 or 7.5 arc lamps, straight series Mazda and the 400-c.p., 15-amp., 600 and 1000-c.p., 20-amp., Mazda series lamps. The units for operating the high-candle-power lamps are equipped with self-contained auto-transformers so that they can be operated on standard constant current circuits of either 6.6 or 7.5 amperes.

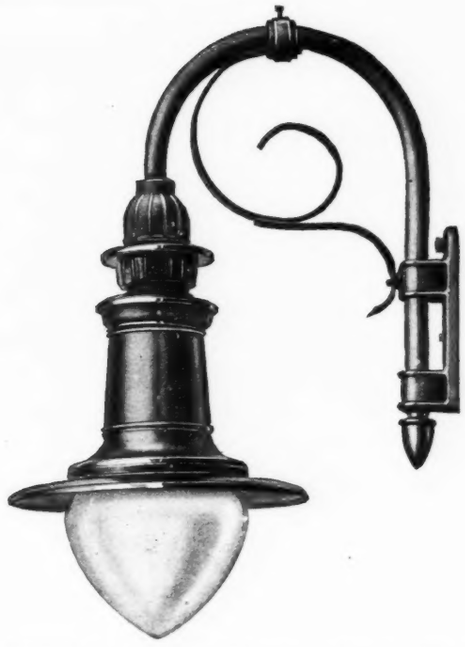
A careful comparison shows that for the majority of installations the high current series Mazda lamps with individual auto-transformers are more efficient and economical to operate than low current 6.6 amp. lamps of equal candle-power rating; furthermore, that the increased efficiency means increased capacity in constant current transformers and other station equipment.

A unit with individual auto-transformer for operating a 600-c.p. Mazda lamp at 20 amperes and equipped with a proper reflector gives about twice as much light as the 7.5 amp. carbon enclosed-arc lamp, and consumes 30 per cent. less energy. Furthermore, the station capacity is increased by 30 per cent. and a reserve capacity secured for possible extensions. No changes are necessary in the lines or cable and the same hangers and cutouts can be used, simply a substitution of lamp for lamp.

The new units are made in two different general types; one for mounting on brackets or permanent fastening to mast arms, while the other is for the regular method of suspension.

The bracket type is equipped with insulator interposing an insulation between the unit and the pole which will withstand voltage strains up to 25,000 volts. This insulator has great mechanical as well as electrical strength, because it is composed of only one massive porcelain. In addition to this important "Safety First" feature, it is adapted for either open or concealed wiring of the unit.

For open wiring the units are furnished with flexible leads equipped with substantially soldered connectors of liberal cross section. Should it be desired, however, the circuit wires can be brought directly into the fixture by simply bringing the leads to the tying ears on the insulator and then thru the porcelain to the interior binding posts.



BRACKET *type of street lamp equipped with light Carrara globe and reflector.*

For concealed wiring the leads can be brought thru the bracket pipe, thru the hood into the top of the insulator and then into the binding posts. The binding posts in the insulator are heavy copper castings, each one being equipped with two phosphor-bronze screws to prevent the possibility of loose connections.

The following three combinations of light distributing equipment can be used with the pendent or the bracket types: No. 87 light Carrara outer globe; No. 87 light Carrara outer globe and 20-inch reflector; prismatic refractor and 20-inch reflector.

The prismatic glass refractor is the most valuable device ever applied to a light source to increase the light at effective angles. Instead of cutting down the light from the bare lamp by absorption, it more than doubles the candlepower values at angles of from 10 to 15 degrees below the horizontal.

The refractor is made of two sections of prismatic glass with the prisms facing each other on the inside, thereby presenting exterior smooth surfaces which will not collect dust or dirt.

The handsome appearance of these units is worthy of more than passing notice. Substantial, simple, but with harmonious lines, they will improve the appearance of any street where they are installed.

One of the important novel features is the method of ventilation. The globe seat is made air-tight. The air enters thru the fine-mesh protected openings under the lower flange of the casing near the globe, circulates around the socket, and leaves thru fine-mesh protected openings under the dome of the lamp. This method gives a liberal supply of cooling air but absolutely prevents the entrance of insects.

The globe holder is hinged to permit ready access to the lamp, and the globe holding device holds the globe firmly and evenly against the globe seat, but is so constructed that it is independent of the retaining screw, thus preventing globe breakage from excessive tightening of the screw. The socket is of the skeleton type. The casing is made of spun copper with a black oxidized finish and is held to the dome by a bayonet joint and set screws. The reflector is made of steel with black enameled top and white fire-enameled reflecting surface.

Canadian Wood Blocks for Paving in Great Britain

Even the paving industry has been effected by the war. Sweden and Russia, when hostilities are over, will find their Douglas fir in the streets of hundreds of English cities and boros.

Many woods have been tried for pavements in the United Kingdom. Jarrah was introduced, but proved unsatisfactory, wearing and breaking off at the corners and edges and producing a very rutty pavement. Red gum from the United States likewise gave poor service. The use of oak was discontinued some twelve years ago on the ground of expense. Pitch pine from the United States was also tried, but it did not wear evenly and produced a rough pavement. Canadian white spruce was laid on the north side of Trafalgar Square in London twelve years ago with an 8-pound treatment of creosote per cubic foot and is still in excellent condition.

Without exception, the wood-block pavement laid in Great Britain before the war was Swedish and Russian redwood (Pinus sylvestris. The specifications issued by the municipal engineers thruout the country admitted this wood and no other, the one exception being the specification for the boro of Westminster, London, which admitted Canadian spruce, red pine, or Douglas fir.

Swedish redwood had three points in its favor—the price was satisfactory, its life was definitely known, and the paving companies handled it. In normal times Swedish and Russian redwood was delivered in 3 by 8 or 3 by 9-inch, 6 to 20 feet long, averaging 16 feet, dressed one side and one edge, for $51.10 to $55.95 per 165 cubic feet. The price rose during the war to $80.30. This timber, sawn into 4-inch blocks and given an 8 to 10-pound treatment of creosote made a pavement lasting in London twenty years under light traffic and twelve years under heavy traffic.

The municipal authorities when contracting for wood-block pavements specified redwood in nearly every case, and the paving companies did not handle any other kind of wood. The influence of the paving companies was all powerful in most of the municipalities when a change of wood was to be considered.

The four Canadian woods that are being introduced in the United Kingdom for paving purposes are Douglas fir, white spruce, jack pine, and red pine.

The supply along the line of the Grand Trunk Railway is unlimited, there being enough still uncut to pave every street, not only in Europe, but in the world, but they can find a sale only on condition that the normal price c.i.f. is less than $53.50 per standard for well manufactured sound grade admitting tight knots not over 1½ inches in diameter, odds and even length accepted.

The city engineers of Sheffield and Westminster have already signified their willingness to accept Canadian wood if the price is lower than redwood, which it now is. Other city engineers are willing to have a trial strip of pavement laid in the city at a reduced cost, or at least wish to be convinced that the new wood has already given satisfactory service in some municipality in the United Kingdom. There is no opportunity for the shipment of creosoted blocks. Creosote costs only six cents a gallon at the creosoting works in England.

Under the English specifications for blocks hearts are admitted; also knots, unless loose or on the upper end of the block, and are sometimes accepted even then.

The extent of this new industry can be realized from the fact that the quantity of timber used by Great Britain for paving in 1913 was approximately 60,000,000 feet.

FIRE DEPARTMENT

Motor Fire Apparatus Increases Fire Department Efficiency

Mr. John R. Keefe, chief of the bureau of supplies and repairs, fire department, city of New York, in his last report to Mr. Robert Adamson, fire commissioner, outlines progress made in the rapid motorization of the department, as follows:

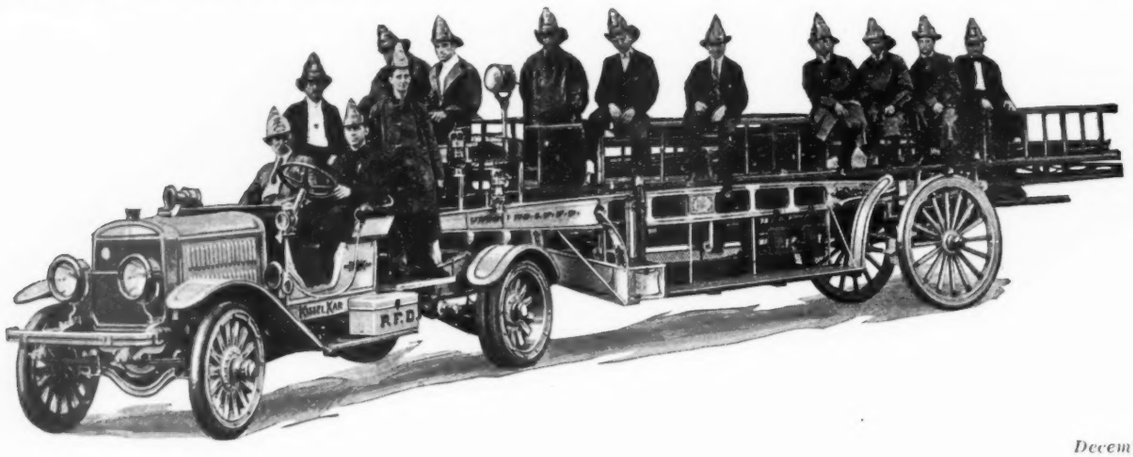
Perhaps the greatest accomplishment, tho it attracts little or no attention among the people outside the department, was the carrying on of the gradual motorization of the department without a single company going out of service and doing it in the most economical manner possible. At no time during the year 1914 has there been what would be ordinarily considered a sufficient number of spare horses or a sufficient number of spare apparatus to allow the motorization to proceed. Changing from horse-drawn to motor means that stalls must be removed, gasoline storage tank installed, floor strengthened in most cases, house electrified if it was gas illuminated, and a considerable change in the equipment of companies, all of which must be done without the company going out of service. The actual change takes place at 8 o'clock on the morning of the day designated, and it has never been found necessary to postpone the taking effect of a change from horse-drawn to motor-propelled.

Constant close watching and careful handling were necessary to meet the many complex situations which arose. The various division heads of this bureau and their subordinates performed the duties devolving upon them in an intelligent manner and to them is due the credit of maintaining the apparatus and equipment at a standard of efficiency and enforcing economy and prevention of waste to a point where the saving effected, which will be more clearly seen in 1915, will in that year exceed the combined salaries of the employes attached to the various divisions of the bureau of repairs and supplies, the saving exceeding $382,000, as compared with the allowance for the same purposes in 1910, the first year of the previous administration.

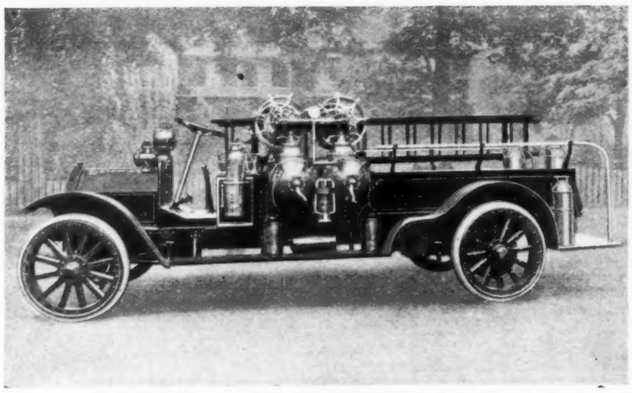
FIRE DEPARTMENT STABLE RECORD.

	Manhattan, the Bronx and Richmond	Brooklyn and Queens	Total
Horses on hand December 31, 1913..	709	599	1,308
Horses transferred from Brooklyn...	5	...	5
Horses transferred from Manhattan..	...	28	28
Horses transferred to Manhattan....	...	5	5
Horses transferred to Brooklyn.....	28	...	28
Horses sold	39	38	77
Horses died	34	30	64
Horses on hand December 31, 1914..	613	554	1,167
Horses given medical attention.....	773	264	1,037
Average price received for condemned horses	$59.37	$59.21	....
Cause of death of horses:			
Injury	9	9	18
Disease	25	21	46

The allowance in 1910 for repairs and supplies and pur-



KISSEL *four-wheel tractor attached to hook and ladder truck, city of Patchogue, L. I.*



FEDERAL *combination chemical and hose truck, city of Dighton, Mass.*

poses other than personal service was $912,898. There has been a 15 per cent. increase in the number of companies since then, which would mean, at the 1910 rate, that an allowance of $1,049,832.70 would be required for 1915. The allowance is $667,752.81, a difference of $382,079.89.

The savings effected at the end of 1914 in various corporate stock accounts will result in turning back to the general or other funds accounts $115,479.34, the work for which the various issues were authorized being completed for that much less than the estimated cost.

The most trying period encountered, which was perhaps the most trying in the experience of the department, was during the traffic conditions which prevailed during February and March. Notwithstanding the many difficult problems which developed and obstacles which had to be overcome, companies were kept in service and the equipment was kept up to a high standard of efficiency. This speaks volumes for the preparedness of the repair shops and the intelligence with which this force met every situation as fast as it developed.

Another difficult problem was the horse situation. Many times it was thought that an emergency purchase of horses would have to be made. Many complaints were received from all boros and continuous requests for new stock. The horse situation is in better shape today than at any time in the last three years, made so by the recent releasing of a large number of horses which was made possible by the motorizing of a large number of apparatus. This permitted a weeding out of bad stock and strengthening here and there with the best horses among those which were released. Many changes of horses had to be made to effect this, with the result that every horse-drawn company now has good stock and there is on hand a healthy supply of spare horses.

ADAMS *combination hose and chemical, city of Findlay, Ohio.*

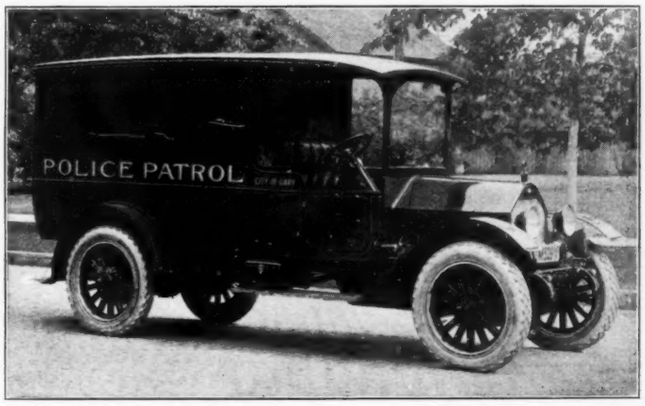
RECORD OF FIRE LOSSES IN NEW YORK.

Year.	Total loss.	Per capita.
1907	$9,413,042	$2.22
1908	9,261,078	2.13
1909	7,431,635	1.60
1910	8,591,831	1.80
1911	12,470,806	2.51
1912	9,069,580	1.79
1913	7,467,997	1.38
1914	8,217,811	1.44

The purchasing division has kept up its good work and with rare exceptions purchases of supplies are made in this department at lower rates than similar purchases by any institution of a like kind, and the quality is second to none. Standard specifications in all cases where they have been prepared have been used and when the great number of items of supplies and materials used by this department is taken into consideration, the rejections on account of quality have been extremely rare. The rigid inspection made by the divisions of this bureau make it very difficult, if not impossible, to supply inferior goods.

In the appropriation account for maintenance of apparatus a saving of $17,000 was effected, and this sum was set aside

SOUTH BEND *police patrol, city of Gary, Ind.*



for the purchase of 4 motor-propelled fuel wagons, each with a capacity of 8,000 pounds. Heretofore all apparatus was purchased from corporate stock funds. Not alone a saving of $17,000 was effected, but in addition these wagons will take the place of 11 horse-drawn fuel wagons, requiring 4 chauffeurs instead of 11 drivers, saving the salaries of 7 firemen at $1,400 a year each, $9,800; and the upkeep is $600 a year on each of the 11 wagons, $6,600, a total of $16,400. The cost of repairs, gasoline, tire upkeep, etc., on each of the 4 motor fuel wagons is estimated at $250 a year, or $1,000 for the 4, making a net saving of $15,400 without taking into account the saving on house heating, illumination, building repairs, etc., which will be effected by surrendering to the Sinking Fund Commission houses now used as fuel depots which will not be required when motor-propelled fuel wagons are installed.

During the year contracts were awarded for 27 motor-propelled combination chemical and hose wagons, a total of 76 pieces of motor apparatus. Most of these were delivered at various periods of the year and several are still due. In the case of tractors the saving in each instance is approximately $480 a year over horse-drawn apparatus which it supplants. Forty-two tractors mean a saving of $20,160 per year. A saving of

this amount will be effected in 1815. During 1914, owing to the different periods at which the tractors were put in service, the saving on tractors will be about one-half of this, or $10,080.

The saving of a motor-propelled tender over the horse-drawn tender is about $260. Thirty-four of these have been contracted for, not all of which have been delivered and placed in service. The approximate saving on the number that have been placed in service is $2,600.

In addition to the saving on motor-propelled apparatus over horse-drawn, the repairing and replacing of stalls, stall drains, etc., in company quarters, where the apparatus has been motorized was always an item of considerable expense, approximately $100 per year in each house. The motorizing of 40 companies means a saving of $4,000 on stalls and drains alone.

On December 31 (8 o'clock a. m., January 1) 9 volunteer companies in the old town of Woodhaven were mustered out of service and the territory previously protected was cared for by the extension of the paid system thereto. To do this 5 new companies with motor aparatus were organized to begin service at the very instant the volunteers were mustered out. This was a job of some proportions. Equipment of every kind, from a broom to a motor-propelled fire engine including coal, gasoline, beds, bedding, tables, chairs, household equipment and all kinds of quarterly supplies had to be furnished by this bureau and be in place so that it was only necessary for the officers and men who comprised the crews of the new companies to take possession at 8 a. m., as active companies. At the same time all the fire department property in the keeping of the volunteer companies had to be taken up and cared for. This included 14 pieces of fire apparatus, 26 horses, about 12,000 feet of fire hose and various other sorts of equipment. The Division of Apparatus and the Division of Stores in Brooklyn and Queens were busy night and day on this job in order to carry it to a successful conclusion, which was done without the slightest friction.

CITY OF NEW YORK FIRE DEPARTMENT, CALENDAR YEAR, 1914.

Number of alarms	16,245	
False and unnecessary alarms	1,820	
		14,425
Fires in other than buildings	2,168	
Fires in vessels	86	
Fires confined to starting point	10,164	
Fires confined to buildings	1,705	
Fires extended to other buildings	302	
		14,425
Fires extinguished without engine streams	8,561	
Fires extinguished with one engine stream	3,701	
Fires extinguished with 2 or 3 engine streams	835	
Fires extinguished with exceeding 3 engine streams	192	
Fires extinguished with 1 high-pressure stream	749	
Fires extinguished with 2 or 3 high-pressure streams	246	
Fires extinguished with exceeding 3 high-pressure streams	141	
		14,425

Ten pieces of property formerly occupied by this department as fuel depots, storage plants and company quarters, have been turned back to the Sinking Fund Commission. At a conservative figure their value is $350,000. The saving, at 4½ per cent, the rate the city usually has to pay for borrowed money, would be $15,750 a year on the value of the property turned back.

Much of the preliminary work on a proposition to consolidate 84 companies in 42 houses as fast as motor apparatus is procured has been done. This with comparatively slight expense for alterations, will result in turning back to the Sinking Fund Commision 42 sites and buildings in addition to the 10 pieces of property already turned over, provided that further study shows the consolidation can be made. The estimated value of the 42 pieces of property is $35,000 in each case. In some instances the property is worth very much more than $35,000. As an average the latter is a conservative figure, the total value of the 42 pieces being $1,470,000, which, together with the $350,000, the value of the buildings already turned over, makes $1,820,000, enough to completely motorize the department. In addition, the city would have approximately $2,000,000 more property to assess, assuring a yearly income of about $35,000.

COST OF MAINTAINING FIRE-FIGHTING EQUIPMENT.

	Total Expenditures.	Salaries and Wages.	Supplies, Equipment Repairs, etc.
Repair shops	$ 91,409.87	$ 76,706.61	$14,793.26
Hospital and training stables, including shoeing	87,001.41	60,528.71	26,472.70
Total maintenance	$178,411.28	$137,235.32	$41,265.96
Maintenance of motor paratus, exclusive of chauffeur service	$ 47,029.25		$47,029.25

(Included in the above are expenditures for new apparatus out of corporate stock funds.)

From January 1 to December 31, 1914, repairs and purchases were made on open market orders amounting to $180,826.70. During this same period in 1913 there was expended for this purpose $333,054.97, a difference of $152,228.27. This was accomplished by closely scrutinizing all requisitions and eliminating those that were not for absolute necessities, and purchasing by contract.

If funds are provided, the completion of motorization will be accomplished by the end of 1917, and the passing of the horse in this department will be a fact. The duty devolving on this bureau, to make repairs necessary and furnish supplies and materials required to keep 292 land companies and ten fire boats in active service, has been fulfilled to the letter, and in a manner so economical as to challenge comparison.

Fire Department Notes

D. F. Lawler, chief of fire department of Bellows Falls, Vt., a city of 60,000, is only 29 years of age. He has been a member of the department for thirteen years. When 22 years of age he was made captain of Chemical Company No. 1, and after three years in that position was promoted to the position of assistant engineer. In July, 1914, when 28 years of age, he was appointed chief engineer. Since becoming chief he has enlarged the sleeping quarters at the central station so as to permit of keeping five men on night duty. He has also inaugurated a monthly drill, which consists of ladder climbing with hose and testing apparatus. A system of building inspection has also been established during the past year.

Frank J. Connery, chief of fire department of Newcastle, Pa., has just completed his sixteenth year in his present position. He has been in the service for thirty-nine years.

Chas. H. Fuller, chief engineer of the fire department of Pawtucket, R. I., was appointed substitute in Hose Co. No. 1 in March, 1891. Was promoted to the rank of captain in 1895 and to that of second assistant engineer in 1900. In 1910 he

was made first assistant engineer and in 1914 succeeded to the position of chief on the death of former Chief Butler. The total fire loss in Pawtucket during 1914 amounted to $98,244.05 and the total insurance paid amounted to $84,050.57. Pawtucket is a city of 56,000 and has nine pieces of motor-driven equipment.

When H. Y. Montgomery, present chief of the fire department of Houston Heights, Texas, was appointed early in 1915 the fire apparatus of the department and all the auxiliary equipment were in a bad state of repair. At that time the department had one Robinson chemical engine and one Federal combination hose and chemical. The new chief has converted the Federal combination into a ladder truck and the Robinson chemical into a hose wagon with chemical. The chief's car consists of a Ford auto equipped to carry a thirty-gallon chemical tank, two three-gallon extinguishers, one ax, one door opener and one Pyrene extinguisher with 150 feet of ¾-in. chemical hose was provided by the council. New auxiliary equipment has been purchased and the department is now fairly well equipped. Mr. Montgomery has, however, recommended the purchase of an automobile pumper, 700-gallon capacity and 1,000-ft. of 2½-in. hose. Under the new chief's direction one day of each week is set aside for fire practice with ladder.

The fire department of Purcell, Okla., was organized in 1904. The present fire chief is Warren Delay. This team has taken active part in all state firemen's conventions and tournaments since 1907 and has made a wonderful record for a volunteer fire department. Purcell has made the best record of any fire department in Oklahoma, having won first honors oftener than any other team.

Chas. H. Simmons, chief of fire department of East Providence, R. I., has been a fire fighter for twenty-one years and has served as chief of his department during the past three years.

R. B. Newman, chief fire department, Park City, Tenn., has served in his present capacity for eight years, or since the start of the fire department. The initial equipment consisted of three hand reels, which was increased by two additional hand reels during the first year. In 1909 the fire chief recommended the purchase of a hose wagon, which was made, and during the same year two paid men were added to the force. In 1910 horse-drawn equipment was supplanted by motor-driven equipment. Mr. Newman reports that the upkeep for the horse-drawn equipment, including feed for horses, amounted to $60 per month. A corresponding charge for motor equipment last year amounted to $1.03 per month. Repairs for the motor-driven apparatus, which is of the American La France make, cost during the last two years, $5.50. Out of thirty-nine runs made last year, twenty-seven fires were extinguished with chemicals and no loss on these twenty-seven fires exceeded $20. Park City is a residential suburb of Knoxville, Tenn.

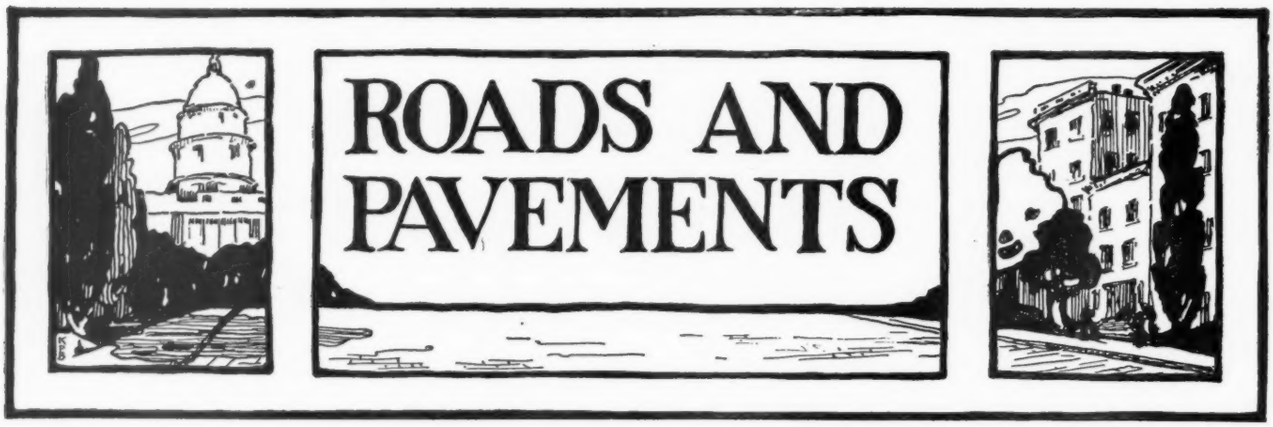
The city of Bryan, Texas, has a fire department composed of two companies, Protection Engine Co. No. 1 and Auto Chemical Co. No. 2. Protection Engine Co. No. 1 was organized May 16, 1871, and chartered July 5, 1871. Its equipment consists of two horse-drawn hose wagons and 850 feet of hose. It has one paid employee, the driver, and five honorary members. Its paid members are as follows: O. E. Saunders, president; G. M. Brandon, vice president; J. D. Mann, secretary; J. W. Wittman, treasurer; L. H. White, foreman; William Ruchti, assistant foreman; G. C. Calhoun, driver. Auto Chemical Engine Co. No. 2 was organized May 4, 1911. Its equipment consists of one American La France combination chemical and hose wagon, 959 feet of fire hose and 200 feet of chemical hose. The officers are as follows: C. G. Wetter, foreman; H. A. Saunders, assistant foreman; John Reed, president; B. Tucker, vice president; A. D. Graham, secretary; R. E. Cole, driver. W. J. Christian, engineer. A. E. Worley, chief of fire department.

The history of the fire department of Newport News, Va., is an excellent example of what may be accomplished when necessity arises. In July, 1891, a large fire destroyed a block of buildings on 27th and 28th streets, between Washington and Lafayette avenues. At that time the city had no fire protection, but the big fire aroused the citizens to action, and shortly afterwards, through a citizens' committee, purchased an American La France steam fire engine, two hose reels and 1,000 feet of hose. A fire company was organized upon the arrival of this new equipment. Later, during the same year, a four-wheel hose carriage was placed in service. In 1892 one second-hand hook and ladder truck was purchased from Petersburg, Va. The city now has in the service a fully motorized department consisting of ten pieces of up-to-date equipment including a tractor and a 65-ft. aerial truck. The department has three modern brick buildings and employs fifteen men. W. K. Stow, the present chief of the fire department, has been actively connected with the department since it was started in 1891. He was made foreman in 1892 and appointed chief in February, 1896, having held this latter position for nearly twenty years. The improvements mentioned above have all been made under his direction and recommendation.

Severe Test of Motor Truck

One day in November a 2½-ton KisselKar truck bearing a capacity load of one thousand five-pound boxes, crashed through a bridge at Strong, Maine, and dropped "on all fours" 20 feet below. It was raised to the road and driven home on its own power.

The truck was owned by F. E. Merrill of Turner, Me., who in reporting the occurrence, says: "The front wheels were in the river, one of them at least 18 inches higher than the other, proving that there must have been a tremendous strain when the machine struck. The rear wheels were 4 or 5 feet up the bank. Yet the only damage done was a broken radiator and a slight sag to the main frame spring. The truck steered all right and the engine ran free. We think this is nothing short of marvelous."



Durability of Creosoted Block Pavements Increased by Modern Methods of Treatment

By Frank W. Cherrington, Toledo, O.

To obtain good service from the modern creosoted wood block street pavement, certain fundamental laws in regard to the treatment and installation of the blocks must be obeyed. Factors formerly considered to be of minor value have been found to be at least equally as essential to the permanence of such construction as the quantity and quality of injected preservative oil.

Some of these often neglected but important factors are: that the penetration or diffusion of the preservative oil thruout the wood volume is no longer wholly dependent upon the quantity injected; that expansion of the pavement cannot consistently be controlled either by the impregnation or surplus amounts of preservative oil in the effort to waterproof the blocks, or by insufficient expansion joints along the curbing; and that a very much less amount of creosote per cubic foot of timber, than that quantity usually specified, is necessary to protect the blocks indefinitely from decay, providing that the lesser quantity is well diffused thruout the wood volume by an efficient process of treatment.

When the modern creosoted wood block pavements were first laid in this country, about sixteen years ago, engineers followed the precedent, which had already been established abroad, and used a treatment of but 10 and 12 pounds of creosote per cubic foot of timber. That this was good engineering practice, is demonstrated by the fact that these pavements are still in an excellent state of preservation.

With the exception of an infinitesimal proportion of the whole, all of the original creosoted wood block streets first laid in this country with a 10 or 12-pound treatment appear to be good for at least another 16-year service without maintenance charges.

An examination of those few individual blocks extracted from these streets which have been found indicating evidences of decomposition, (less than one-tenth of 1 per cent. of the whole) has shown the deficiency to be due entirely to a lack of penetration in the sap wood. This is a condition easily remedied by modern processes of treatment.

The amount of injected creosote oil was first increased above 12 pounds in this country, not for the purpose of more efficiently preventing decay, but because it was thought that additional quantities of oil would make the block more nearly waterproof. However, experience has proven that the existence of large quantities of preservative oil in the blocks will not consistently control or prevent their possible destructive expansion. This force of expansion may be far more efficiently overcome than by a dependence upon the waterproofing effect of large amounts of injected creosote oil. A spacing between the ends of the individual blocks comprising the pavement, secured by some mechanical means or uniform collapsible lugs, not only prevents the possibility of swelling, due to expansion, but at the same time retards both bleeding and slipperiness.

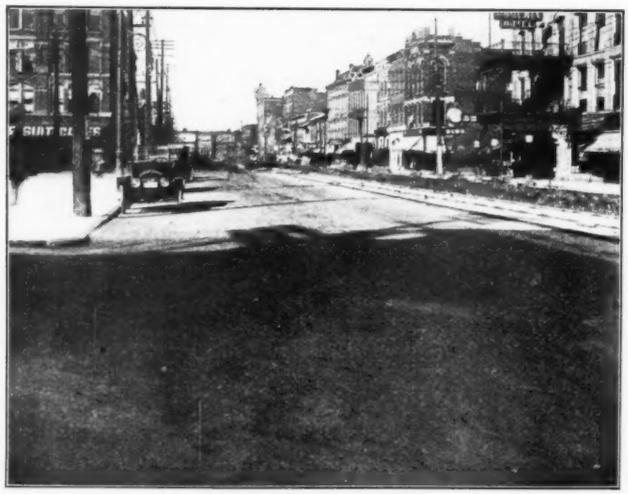
Surplus quantities of oil also bleed or exude to the surface of the pavement to the great annoyance of traffic and pedestrians; therefore, as heavy treatments of 16 and 20 pounds of creosote oil do not accomplish the waterproofing purpose for which they are injected, engineers are returning to a standard of 12 pounds to prevent decay.

Sufficient data, compiled from results secured both in this country and abroad, are at hand to prove that 12 pounds of creosote per cubic foot of timber, properly diffused thruout the wood as is possible by modern processes, will give an indeterminate freedom from decay.

But, if 12 pounds are used, it is imperative that a more efficient means of preventing possible destructive expansion be provided than the presence of often inadequate expansion joints along the curbing.

The quality of the creosote oil recommended by the various engineering societies has been established beyond question by government engineers. It has been proven that the average commercial creosote oils in this country have a toxicity or antiseptic value so great that, providing they may be properly diffused thruout the wood, less than one-tenth of the quantity

CREOSOTED WOOD BLOCK *on Main street, Findlay, O., treated with* 12 *pounds of oil per cu. ft., to prevent decay. Note the presence of lugs to protect against possivle destructive expansion.*



CREOSOTED WOOD BLOCKS *on Demombreum street, Nashville, Tenn., treated with 12 pounds of creosote per cu. ft., to prevent decay. Note lugs on the blocks, as well as expansion joints at the curb, to guard against possible effects of expansion.*

ordinarily injected would be required to retard decay indefinitely.

Methods of treatment used fifteen years ago, and still in use by many cities, have become practically obsolete, inasmuch as it is impossible to obtain a good preservative penetration even when excessive quantities of oil are injected.

Years ago no provision whatsoever was made for equalizing the resistance of blocks under treatment to the gradual absorption of creosote oil. Wood is very complex in its structure, and its moisture content varies so that even when blocks are cut from the same plank no two will be identical; therefore, the oil as it is gradually being forced into the wood naturally permeates and penetrates some blocks more than others, resulting in an unsatisfactory and non-uniform penetration.

Since it is impossible to obtain as good results from old processes of treatment, specifications are being changed so that from a preservative standpoint, both uniformity of peneration and protection against expansion, and no excessive quantity of preservative, are the more important requirements.

Modern creosoting processes provide an even resistance against the gradual absorption of the preservative being forced in under pressure. This resistance is created by equalizing the moisture contents of the blocks by admitting live steam, followed by the application of a vacuum, or the initial injection of air under a considerable pressure to serve as a uniformly resistant cushion in every fiber of the wood against the penetration of unequal amounts of creosote. At the same time the more fluid air opens a path for the more complete penetrance of the preservative.

Modern creosoting processes permit an adequate diffusion of 12 pounds of creosote per cubic foot of timber thruout the volume of the blocks. Therefore, the life of pavements so treated will be indefinite, providing proper spaces are required to be left between the ends of the blocks as they are installed in the pavement, to serve as a factor of safety against possible bulging.

Good preservative penetration is essential to good wood preservation, but good penetration and protection from expansion are no longer necessarily dependent upon the quantity of injected preservative oil.

Concrete Roads of Wayne County, Michigan

The ninth annual report of the board of county road commissioners of Wayne county, Michigan, for the year ending September 30, 1915, is issued promptly and shows graphically by many pictures the roads of the county and the processes of making them. The "Story of a Wayne County Concrete Road" is repeated from last year's report by request and shows in considerable detail all the steps in the process of securing a road from the report of the board recommending action by the board of supervisors of the county to the opening of the road to traffic after it is completed by the board's forces.

Maintenance of the completed roads is a necessity and is emphasized in the report. Following are some extracts on this subject:

In highway construction two factors—cost and efficiency—must always be foremost in considering the type of construction to be selected. The taxpayer is generally most interested in cost, but often fails to appreciate the fact that first cost is relatively a secondary consideration. Low first cost might and generally does, mean that ultimate cost will make construction of low initial price the most expensive in the end. "How much will it cost?" should include careful estimates as to what maintenance will be necessary to keep the road in condition as nearly comparable to new as is possible and so render its purchasers—the taxpayers—the greatest value for their money. For this reason first cost is not the sole measure of efficiency.

To think that a road once built, regardless of the material used, is built for all time is erroneous. No type of construction, however nearly it may approach perfection, is free from the human element, a factor which plays an important part towards efficiency. Recognizing that durability and low cost of maintenance, as mentioned in preceding reports, largely determine the success of any type of road, our preference, based on our past seven years' experience, continues to be for concrete construction. We believe in constant and systematic maintenance of all roads under our jurisdiction. As in past years, our gravel and macadam mileage continue to absorb the bulk of our maintenance moneys and energies. We have repaired and oiled all gravel roads and in addition thereto dragged them systematically in both the spring and fall. The macadam mileage on Eureka, Fort and Mt. Elliott roads has again been resurfaced at a heavy expense and will eventually be replaced with concrete. The macadam mileage on the River road was oiled in the spring for the convenience of the public, pending its replacement with concrete, which work is now in progress. The macadam mileage on Gratiot road was replaced with concrete. All ditches and cluverts were cleaned out both in the fall and spring, weeds and brush cut and burned several times during the year, all guard rails and bridges painted wherever necessary, and the shoulders given whatever attention they required.

With about 45 miles more of road to look after, part of it two years and part of it a year older, we have spent a smaller sum by $5,178.04 over our maintenance cost of 1913. This has been brought about by the replacement of a number of miles of bituminous macadam with the more durable and less expensively maintained concrete. The wisdom of building of concrete, in our judgment, stands out conspicuously when maintenance cost involved in keeping all other types of roads under our jurisdiction in usable condition is compared with the actual cost of maintaining concrete. Yet even the best concrete road will require some maintenance, consisting principally of cleaning out and refilling expansion joints, the repair of pockets which occasionally appear on the surface as a result of some foreign material such as clay getting into the concrete, some fragment of inferior pebble or stone, or defects in workmanship. Usually no maintenance is required

on our concrete roads the first year of their life, but if we find that any is necessary we do it promptly and thoroly.

A crew consisting of seven men and a team, provided with a tar kettle, is used for our maintenance work. The foreman is paid $5.00 a day, the team and driver $5.00 a day, tar man $3.00 a day, two laborers $2.50 a day each, and two laborers $2.25 a day each. The tools used consist of several wire bristle brooms, a wheelbarrow, a couple of shovels, and a tar bucket and sprinkling cans. Two men are utilized to sweep all cracks or spalled joints clean with the wire brooms, after which the man with the tar can fills the cracks with tar, which is heated to about 225 degrees Fahrenheit, allowing it to stand for a few moments to prevent it from bubbling. It is then covered with a clean, coarse, dry sand, spread from a shovel. Pit holes are similarly treated. An excess of tar and sand is used and traffic is allowed to iron it out. We use a grade of tar known under the trade name of Tarvia, with a melting point of about 85 degrees Fahrenheit. Tarvia comes in several grades designated by letters, and we use a special mixture graded between Tarvia A and Tarvia X. Where an imperfection exists that does not extend thru the road, but is over an inch in depth, we clean it out and dry it out carefully, painting it with hot tar, after which it is filled with stone of a suitable size graded to fill the voids as nearly as possible, tamped down or rolled into place. Hot tar is then poured over the patch, the quantity being gaged so that the tar will be taken up by the remaining voids without any large excess being left on the surface, and coarse, dry sand is then spread with a shovel over the surface. Holes of a lesser depth and any joints from which the filler has wholly or partly disappeared come in for the class of treatment already described for cracks and joints.

Our maintenance crew will cover from one to three and one-half miles of road in a day and one trip over the work yearly is usually all that is required. During the past season our maintenance crew had gone over our entire concrete mileage for the year by the middle of August. On Fort, Grand River and Gratiot roads we have a total of about two miles of concrete road where the entire surface is covered with a bituminous carpet. This mileage has also been taken care of as during the past. The same grade of Tarvia is used as for other maintenance purposes. Instead of sand, washed and screened pebbles are used. It is necessary to resurface about one-third of this mileage annually in addition to touching up spots here and there thruout the entire season. The method followed has been to sweep the spots to be treated with wire brooms, after which the tar is poured. The pebbles are then spread over the tar from barrows or a wagon, and traffic imbeds the pebbles in the tar, forming the wearing surface. The surfaces of these roads become wavy under traffic and are not as desirable as an all-concrete wearing surface, either from the standpoint of the comfort of the user or from the standpoint of ultimate cost. We have also repaired a few holes that were two or more inches deep by cleaning them out, painting them with a cement grout, and filling the cavity with a concrete mixture of the same proportions as that used in the construction of the original road, the concrete being mixed to the same consistency as nearly as is possible to that of the original construction. The repaired portion is cured by being kept wet for at least seven days and protected from traffic until thoroly hardened. A comparison of our maintenance costs with those of other localities where roads are maintained in good, usable condition and where $1,000 a mile and upward each year is being spent will prove instructive. Our concrete roads possess the special feature of presenting a surface that wears but slightly and uniformly; a surface that does not give away in any one spot and withstands traffic over its entire surface. This is made possible by careful selection of materials, careful methods of proportioning and mixing, and care in finishing and curing, resulting in a concrete having a uniform texture, which is a big factor in eliminating maintenance costs. We have over 125 miles of concrete road in Wayne county, some of it in its seventh year of service, all of it in good condition, and we have never taken up and replaced a 25-foot section since we have been building and developing this type of road, which, we think, speaks volumes for our low annual maintenance costs.

On our brick mileage we have treated the cracks which have developed and the bricks that were not too badly chipped in the same manner as we handled the cracks on our concrete roads. It has made a very satisfactory repair and gives promise of adding materially to the life of our brick roads. Broken brick have been replaced from time to time and the roads given an occasional sweeping and cleaning.

We have also found it advisable to use a road scraper to keep the snow leveled down during the winter months, more especially on the roads on which there are street car tracks. The scraper was drawn behind a motor truck and made travel much safer, besides distributing it over a wider area of roadway. In fact, every effort is made to keep our roads in proper condition for travel throughout the entire year with a minimum of expense.

The cost of this work during the past year has been $25,355.64.

Non-Resident Users Should Pay Their Share of Cost of Roads

To build and maintain good roads for the benefit or pleasure of non-resident users is a proposition the farmer doesn't relish.

CONCRETE ROAD IN NEW YORK STATE.

It is the purpose of the Illinois Highway Commission to build all leading highways of the most durable materials it is possible to obtain in order that the maintenance factor may be reduced to a minimum. To improve the leading roads of the state will require, it is estimated, an expenditure of approximately $180,000,000, and no farmer will be more than 4½ miles from these state-aid roads. At first glance this would seem to be prohibitive in cost, so far as the farmer is concerned. It has developed upon inquiry, however, that the greater part of construction cost, as well as maintenance, will fall upon corporations and municipalities, and that the farmer's share of the tax, taking the average, will be only 8 cents per acre per year until the bonds mature, which will be at the expiration of about twenty years. If the estimates of the Highway Commission are correct in so far as they affect the farmer, a man owning 100 acres of land would pay only $8 per year for an improvement worth many times that sum. Instead of being a tax, hard roads of the type Illinois proposes to build will be of direct and immediate pecuniary profit to the farmer taxpayer. This expenditure, like the money he puts into seed grain, or a herd of cattle, produces profit. As a matter of fact, the pecuniary return to the farmer thru saving of time, cost of transportation and the losses incident to bad roads would be more immediate than from a field of grain. Furthermore, the corporations and municipalities of the state will contribute at least 60 per cent. of the money invested in the improved system of roads.

Turning to the state of New York, it is said that the farming sections pay only 15 per cent. of the cost of the extended system of highway improvement now being made thru state aid. A New York farmer, who complained at a public meeting against "being ground to death by highway taxes," admitted that an improved road in his locality had brought him an offer of $500 more than he had previously considered his property to be worth. He owned a farm assessed at $3,000. He was very frank to state that the increased value of $500

was due entirely to this road. The increase in the value of his farm was sufficient to pay his share of the highway expense for 150 years. The interest on it at 6 per cent. for 12 years would pay his proportion of the 50 years bonds. His individual burden amounted to less than one cent a day and will not go over that figure when the highway system is entirely completed. It is needless to say that the farmer in question was surprised and immediately revised his opinion as to the cost and value of permanent roads.

As stated, the Illinois project has to do with main or leading highways only, but it is interesting nevertheless to compare with this the situation in other states as it applies to road tax in general. For example, in one of the leading agricultural counties in Pennsylvania, the county of Bucks, road tax as levied by the townships runs from 4 to 10 mills on each dollar of assessed valuation, depending upon the extent of highway improvement. A fair average would be 6 mills. Thus a farmer owning 100 acres of land assessed at $100 per acre would pay $60 road tax each year. A great majority of the highways are of the most ordinary type, many of them almost impassable at certain seasons of the year. In contrast to this the Illinois farmer will always be in touch with a fine system of durable highways, for the construction of which his contribution of 8 cents per acre will be a mere pittance, and his tax for maintenance of the local roads will be very greatly diminished by taking off his shoulders the maintenance of the most expensive roads in his county, to repair the main traveled roads.

But it is important to remember that the whole success and economy of the Illinois project comprehends the construction of roads of such durable type that they will be in good condition many years after the bonds mature. If it were intended to build merely macadam roads the project would be futile. In the states of Massachusetts, Connecticut, Rhode Island, New York and New Jersey, maintenance costs on macadam roads ran, in 1912, in excess of $800 per mile. The roads were rapidly destroyed by automobiles.

The Illinois roads will be of brick or concrete. The brick roads will have a concrete foundation with the superstructure of brick grouted with Portland cement. The average cost of concrete roads 16 feet wide, taking the country over, has been $12,000 per mile. The average maintenance on concrete roads 16 feet wide has been less than $30 per mile per year.

A Concrete Road in the Illino's River Bottom. Floods Ruined All Previous Roads.

The value of farm lands on hard roads in Wayne county, Mich., has, in many instances, more than doubled. Farmers who formerly required four horses to transport their produce to town now use one horse. Where trips to market formerly occupied an entire day, or perhaps two, the journey is now made in a few hours. The greate department stores of the city deliver merchandise over a wide area, going now into what were formerly remote rural districts. In brief, many of these farms, in so far as easy access to the city is concerned, have become suburban properties.

Des Plaines, Ill., Dedicates New Pavements

With the recent completion of the pavements on the North Side of Des Plaines, Ill., that village now boasts of over six miles of pavement in the heart of the business and residence sections. Village officials take just pride in the completion of this work, and on Saturday, October 30, they brought it forcibly to the attention of the citizens by a formal dedication ceremony, including an automobile parade, speeches by city and road officials, a flag-raising and breaking of bottles of champagne on North and South Side streets.

The affair was held under the joint auspices of the village board of trustees and the Des Plaines Commercial Association. Officials from twenty neighboring cities were escorted over the new work by Des Plaines representatives under the direction of Geo. M. Whitcomb, marshal of the day, and Coroner Peter M. Hoffman, master of ceremonies.

An automobile parade, over a mile in length, first inspected the majority of the reinforced concrete pavements laid on the South Side last year, then crossed the railroad tracks to the North Side and traversed the new pavements laid in 1915, the last stretch of which was just recently completed. Following the guide cars, was the fifty-piece Des Plaines military band in a large auto bus. At the conclusion of the street inspection, the people listened to talks by Patrick H. O'Donnell, an attorney of Chicago; the Hon. Frederick R. DeYoung, state representative, and A. D. Gash, president of the Illinois highway commission. Led by the military band, the populace then repaired to Pearson street, where Miss Esther Sigwalt and Miss Viola Suster dedicated the South Side pavements with a bottle of champagne and the words: "We herewith christen the concrete pavements on the South Side of Des Plaines." Following this, Miss Clara Hass and Miss Edith Jarnecke acted similarly as sponsors for the formal dedication of the North Side pavements, where an American flag was raised to properly conclude the day's festivities.

The paved streets cover over half of the main portion of Des Plaines, which is a larger percentage than is enjoyed by most cities and an exceptionally high percentage for villages with a population not exceeding 3,000, the population of Des Plaines. Citizens are well pleased with the improved civic conditions and declare that from a financial standpoint alone, the boost the new streets will afford Des Plaines in a business way and in increased property valuations will exceed the actual cost of improvements by a wide margin. A substantial indication of the satisfaction in the paving work is the fact that contract will soon be awarded for concreting the remaining portion of Ashland avenue and a short stretch on Emma street. New pavements on other streets also are contemplated.

Specification of Oil for Creosoting Wood Paving Blocks

Before the American Society of Municipal Improvements at its Dayton convention, Hermann von Schrenk presented a paper on specifications for wood block paving which produced a marked effect upon the members present and will lead probably to a material change in the specifications for wood block paving proposed as standard, which have not yet been adopted by that society.

Some abstracts from the paper follow, showing the conclusions drawn but omitting most of the technical detail upon which they are based.

The discussions concerning wood block paving specifications in the United States have, with few exceptions, dealt very largely up to the present time with specifications attempting to describe the kind of preservative oil to be used in the treatment of paving blocks. These discussions dealt with the relative advantages and disadvantages of straight coal-tar creosote, additions of refined coal-tar to creosote, water-gas tars, etc. The writer has for many years frequently questioned the practical value of many of these discussions, particularly the desirability of placing so much emphasis on what appeared to him to be more or less unimportant details with reference to the character of the oil used.

The discussions as to paving block specifications have to date been very largely theoretical. Many streets, however, are now ten to fifteen years old, and some even older, and it appears possible to draw some interesting conclusions from the results so far obtained. During the past year the writer has made many detailed examinations of wood block pave-

ments in various cities of the United States, which have given service of from ten to fifteen years and more. The results of these inspections clearly show that in the majority of cases, in fact practically universally, streets paved with creosoted yellow pine blocks had not only withstood the heaviest traffic successfully and resisted decay, but had shown probably a lower annual cost for maintenance than any other kind of pavement. There appears to be no longer any doubt but that properly creosoted yellow pine blocks, when carefully laid, give the best paved streets. The inspected pavements referred to have shown some failures, as was to have been expected. The most striking failures were doubtless due to improper laying, meaning by this improper construction of the foundations, the omission of proper expansion joints, failure to provide drainage, etc. These omissions from standard practice were in the majority of instances so self-evident that there could be little argument about the cause for these failures. Failures due to decay of the blocks were far less numerous; in fact, of the streets examined, only a very small number showed any signs of failure due to decay, and even in the streets where failures did occur, the percentage was insignificant, the failures only resulting after a comparatively long period of years. It was believed, however, that some possible lessons as to further treatment could be obtained by careful investigation of the failures, with a view to correcting same in future practice.

The first failed blocks examined were from two streets in St. Louis, namely, Washington avenue and Westminster place. The wood blocks on Washington avenue were treated with Kreodone oil in 1903. Some two years ago holes appeared in this street, scattered irregularly over the surface, some affecting only one block, others blocks in groups. A detailed examination showed that the wood fibres had given way, with consequent settling. When sectioned thru the center, it was found that these blocks were decayed to various degrees in the sapwood. In not a single instance was any decayed heartwood found. The holes in Washington avenue were temporarily filled with filler, and as the number of holes increased somewhat in 1915, a general overhauling was given the street, the old blocks were removed and replaced by new creosoted blocks. Incidentally, it was striking to note how perfect the repairing of a creosoted wood block street can be if done with care and attention. Today Washington avenue looks just as it did when first laid, and the street is practically as good as new. The total number of blocks removed was probably between 5 and 8 per cent.

Similar descriptions were given of the conditions in other streets in St. Louis, Toledo and Charleston, S. C., analysis of the oils extracted from the blocks were given, and reasons were given for such failures of blocks as were observed, the conclusions drawn from all of the examinations being that the most important factor responsible for these failures was the lack of proper sap penetration, and that in several instances decay was undoubtedly hastened by the use of oil not a straight coal-tar product.

The lesson to be learned from the experiments just described and from examinations of old paving blocks which have been in the streets many years, and which are still perfectly sound, indicates that absolute penetration for every block can not be obtained. It also shows that this is absolutely unnecessary. It shows strikingly, however, that perfect sap penetration is absolutely essential. This can easily be obtained, provided sufficient oil quantities are used and provided the process of injection is properly conducted. There is no excuse whatever for shipping paving blocks from any creosoting plants, no matter what the oil used may be, in which any number of paving blocks are included which show only partial sap penetration. It makes no difference whether this is with a straight creosote distillate oil or with a reasonable coal-tar and creosote solution. There are plenty of instances, both in the case of paving blocks and in the case of railroad ties where timbers have lasted for years and years, with only a very small penetration on the outside, but in all cases the sapwood had been thoroly penetrated.

In conclusion the author emphasizes that the most important part in the present consideration of paving block specifications is not the oil specification. This is a very vital part, and a straight coal-tar product free from the admixture of other substances should be specified, and the specification cannot be too rigid to accomplish this purpose. There are other factors equally as important, however, as the oil specifications, and these are chiefly the specification dealing with the manner in which the oil is to be injected into the timber and the quantity to be used, and the subsequent methods used in laying and caring for the blocks.

Treat preferably partly dry timber and steam same to reduce the gaseous contents of the wood cells. If the timber is green, steam it longer and then give a sufficient time of pressure and a sufficient oil quantity, so as to insure absolute sap penetration. If any lesson can be drawn from the results of the failures herein described, they certainly indicate that, while emphasis should be placed on the oil used, just as much attention should be given to the manner in which the good preservative specified is applied.

Brick Roads Grow in Favor

A rapid increase in the mileage of vitrified brick roads in this country is predicted in a new bulletin of the U. S. Department of Agriculture. Such roads, it is said, possess three distinct advantages: First, they are durable under all traffic conditions; second, they afford easy traction and moderately good foothold for horses; and third, they are easy to maintain and keep clean. On the other hand, they are unquestionably expensive to construct, and the effort to reduce the high first cost frequently results in inferior construction and consequent defects.

The cost of a brick pavement depends so much upon so many variable factors, such as the locality, freight rates, and the distance from brick kilns, that it is not possible to make any definite estimates. The cost of the rough grading, however, should be considered entirely apart from the cost of the pavement, for the grading would have to be done no matter what kind of a road was to be built. Excluding this item, the bulletin already mentioned (No. 246) furnishes the following formula as a rough guide for the probable expense of a brick road with a 6-inch concrete foundation and suitable grades: Cost per square yard $= 1.90\,L + 0.213\,C + 0.138\,S + 0.157\,A + 0.040\,B$.

In this formula C equals cost of cement per barrel, S equals cost of sand per cubic yard, A equals cost of coarse aggregate per cubic yard, B equals cost of paving bricks per 1,000, and L equals cost of labor per hour. Thus, if labor costs 25 cents an hour, the labor cost per square yard of pavement will be 1.93 times 25 cents, or 48.25 cents. The cost of the cement per square yard will be 0.213 times the price of a barrel, and so on with the other items. It is assumed in this formula that all materials are delivered on the work. About 10 per cent. should be allowed for wear on tools and machinery, and for every inch subtracted or added to the thickness of the foundation there will be a corresponding difference of 8 to 12 cents per square yard. Specifications for materials and methods of laying are detailed in the bulletin, which is well worth asking for.

MISCELLANEOUS

Civil Service Examinations

The U. S. Civil Service Commission will hold examinations at the usual places as follows:

December 8, 9: Marine-engine and boiler draftsman in U. S. Navy Yard, New York, at $5.04 a day.

December 21: Marine-engine draftsman for submarines in office of inspectors of machinery, Fore River Shipbuilding Co., Quincy, Mass., and Busch-Sulzer Co., St. Louis, Mo., at $5.04 a day, and other possible vacancies at $4 to $5.04.

January 5, 6: Marine-engine and boiler draftsman in industrial department in Navy Yards at Portsmouth, N. H., at $3.52 a day, and Norfolk, Va., at $3.52 and $4.48.

January 12, 13: Aid in Coast and Geodetic Survey, at $900 a year.

January 19: Laboratory aid and engineer in forest products laboratory at Madison, Wis., at $900 a year.

January 19, 20: Junior engineer in water resources branch of Geological Survey, at $1,080 to $1,200 a year.

The Paving Brick Men

The *Dayton Daily News* published the following in an editorial in one issue during the recent convention of the National Paving Brick Manufacturers' Association in that city. The writer's vision of the future may be colored too much by what he would like to see, and the association near by seems to loom greater than those held in other cities, nevertheless, the article is a compliment to an important industry which bears the marks of sincerity as well as enthusiasm.

The paving brick men are with us—husky fellows who are engaged in making the material that is lifting us out of the mud. They are here from all sections of the country—men who preside over big plants and little ones—and they are attending to business while having a good time.

It has been a struggle, and there are still many contests on, but this is to be a brick-paved nation. It is being demonstrated every day that other paving is a makeshift, or that it at least answers only a temporary purpose. Brick is the road; and the sooner every community recognizes it, and makes arrangements to vitrify its roads, the better it will be—and the cheaper.

Nature has nothing in her storehouses that is superior to a properly made brick. In her furnaces she has produced nothing that so well serves the purposes of man. In the deposits she has left for us to grovel in, she has placed no greater value than in the clays. She has wrought many wonders, but nothing so wonderful as her natural product which we call silica, and out of which we have fashioned so many articles of use and comfort.

These paving brick men are assuming, however, a tremendous responsibility. The prosperity of the community, in fact, is in their hands. They can help us to secure the proper roads, or they can retard us in the game. For they are to have much to do with helping us to secure the best of roads at the most ecomonical of prices. It is unfortunately true that every time a manufacturer sends out a poor grade of goods it retards the adoption of such goods to a certain extent.

That is one of the advantages of such conventions as this of the paving brick men. It enables them to get closer together, to co-operate more fully with the legitimate and to help weed out the illegitimate manufacturer. So we are all interested in the meeting being held here at this time. It brings us a little nearer to the era when one can travel on a brick road from one section of the nation to every other section.

A Municipal Thanksgiving Service

The Commercial Club of Cuero, Tex,. is responsible for its first Municipal Thanksgiving Service, called by Mayor H. A. Mugg's proclamation, participated in by the churches, the municipal band, the municipal choir and other organizations, as well as the people at large. The collection taken is to be the beginning of a fund for purchasing and improving one or more of the beautiful natural parks adjacent to the city.

Municipal Home Rule for Kansas

At its recent convention, the Kansas League of Municipalities passed the following resolutions:

Whereas, The question of greatest importance before the cities of Kansas is that of local self-government, or municipal home rule, subject to the constitution and the general laws of the state, therefore

Be it resolved, That this league, in convention assembled, hereby reiterates its position upon this great question, and that it urges upon its members that they ascertain the position all members of the legislature may take in the event of their election and that they lend support to candidates whose views are friendly; that all requests for legislation be made secondary to this one request for home rule for the municipalities of Kansas; that the league reiterates its position in favor of the submission and adoption of an honestly drawn and workable initiative and referendum amendment to the state constitution, believing this government should be one "of the people, for the people, and by the people."

Technical Schools

Announcement has been made of the courses for 1915-16 and the names of the lecturers in the graduate course in high-

way engineering of Columbia University, New York City, which are arranged so that the entire work can be taken in one year, from October 1 to June 1, or in two years, each occupying December to March, inclusive.

Leaflet No. 61 of the Department of Agriculture Extension of Purdue University, Lafayette, Ind., contains instructions for the construction and use of the road drag, by Prof. Geo. E. Martin, of the University Department of Highway Engineering.

Highway Bulletin No. 1, by Geo. E. Martin, professor of highway engineering, is on the Maintenance of Indiana Highways, and is the first of a series of proposed bulletins on highway construction and maintenance to be issued by the Engineering Departments of Purdue University, Lafayette, Ind., under the supervision of Prof. W. K. Hatt, the Professor of Civil Engineering.

Municipal Reference Bulletin No. 3 of the Extension Division of the University of Wisconsin, at Madison, reports upon the use of voting machines in Wisconsin.

The University of Illinois has registered 1,192 students in its College of Engineering thus far this year, not including the graduate school.

Announcement of the time table of courses in the Graduate Course in Highway Engineering of Columbia University has been issued. The courses are given in periods of two to three weeks, the regular courses announced being fourteen in number and all included between December 1, 1915, and March 22, 1916. There is also a course in bituminous materials, bituminous surfaces and bituminous pavements to be given in evening periods, January 25 to March 16.

Calendar of Meetings of Associations

The Montana Institute of Municipal Engineers will meet in Billings, January 17-19, 1916. C. C. Widener, secretary, Bozeman, Mont.

The second Pan-American Scientific Congress will be held in Washington, D. C., December 27, 1915, to January 8., 1916. The preliminary program, issued by the U. S. Department of State, shows a division into sections, devoted to Anthropology. Dr. W. H. Holmes, chairman; Astronomy, Meteorology and Seismology, Dr. R. S. Woodward, chairman; Conservation of Natural Resources, Agriculture, Irrigation and Forestry, Geo. M. Rommel, chairman; Education, Dr. P. P. Claxton, chairman; Engineering, Gen. W. H. Bixby, chairman; International Law, Public Law and Jurisprudence, Dr. J. B. Scott, chairman; Mining, Metallurgy, Economic Geology and Applied Chemistry, H. Jennings, chairman; Public Health and Medical Science, Gen. W. C. Gorgas, chairman; Transportation, Commerce, Finance and Taxation, Dr. L. S. Rowe, chairman. John Barrett is secretary-general, with offices in the Pan-American Union, Washington, D. C.

The American Road Builders' Association will hold its 1916 convention in Pittsburg, February 22-25, the exhibits in Mechanical Hall of the Exposition building, which will be improved with cement floors and a heating plant, and the convention sessions in a hall adjoining. The directors having decided to change the usual date of the convention from fall to winter months, either it would be necessary to omit the 1916 convention or to hold it only a few months after the San Francisco Exposition Road Congress of last September, and the latter was decided upon.

The National Conference on Concrete Road Building will be held in Chicago February 15-18. J. P. Beck, 208 South LaSalle street, will send the preliminary program on request and the completed program as soon as it is ready.

An international road congress is announced for December 14-17, to be held under the auspices of the Worcester (Mass) Chamber of Commerce, in the New Bancroft hotel, in that city.

The annual meeting of the Montana Institute of Municipal Engineers will be held in Billings, Mont., January 17-19, 1916. Carl C. Widener, Bozeman, secretary.

The Iowa section of the American Water Works Association holds its first annual meeting December 3 and 4, at the State University, Iowa City, Iowa, and the program indicates a vigorous organization which will be of much value to its members and to the state of Iowa.

The ninth Chicago Cement Show, to be held February 12-19, 1916, already has a list of over 150 exhibitors, and will occupy both the Coliseum and the Armory, which will be connected by a covered passageway. A joint exhibit of twenty-six cement companies will be a very prominent feature. Concrete road building machinery will also be prominent.

The American Concrete Institute will hold its next meeting in Chicago in connection with the Chicago Cement Show of February 12-19, 1916.

A Road Commissioners' Convention is to be held in Chicago, beginning December 7.

Personal Notes

Henry Welles Durham, recently chief engineer of highways, boro of Manhattan, New York, and formerly resident engineer on Panama municipal improvements and on the Cape Cod canal, has associated himself with Percival Robert Moses, consulting electrical and mechanical engineer, in the practice of highway and municipal engineering, at 366 Fifth avenue, New York City. Mr. Durham recently published a report on street paving and maintenance in European cities, the result of studies on the ground.

Wilber A. Ginn, consulting engineer, Sanford, Fla., has been retained by St. Cloud, Fla., to design a sanitary sewer system, water works, electric light plant and street improvement system.

John T. Fetherston, commissioner of street cleaning, New York City, is the first president of the new Society for Street Cleaning and Refuse Disposal of the United States and Canada.

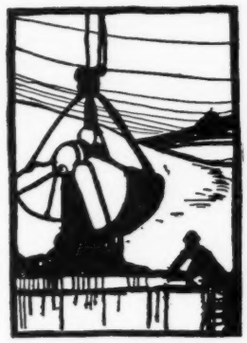
Henry L. Collier, well and most favorably known in the paving field, has opened offices as consulting and constructing engineer in the Chandler Building, Atlanta, Ga., and will devote himself specially to street and highway pavements and reinforced concrete construction. Mr. Collier has a well-deserved reputation, especially in the South, for good service in locating disputed land lines and boundaries.

D. Ward King, originator of the split-log road drag, has published a letter, in which he protests against the methods of use of the drag recommended in Farmers' Bulletin 321 of the U. S. Department of Agriculture, in general and in particular.

Logan Waller Page, director of the U. S. Office of Public Roads and Rural Engineering, has issued a letter giving his reasons for resigning as a member of the board of directors of the American Road Builders' Association, in the calling of a convention of that association before the expiration of the year agreed upon when the Oakland road congress was called.

H. O. Swoboda, consulting electrical engineer, Pittsburg, Pa., has been retained by Massillon, O., to make plans and specifications for a new street lighting system, the present contract expiring in April, 1916.

A. R. Hirst, state highway engineer under the Wisconsin Highway Commission, with offices at Madison, Wis., is chairman of the committee on Forms of Specification of the National Conference on Concrete Road Building, which will be held in Chicago, February 15, 1916. Wisconsin is developing the construction of good roads, and Mr. Hirst is a large factor in this work. Standardization of specifications is very desirable and this committee promises a valuable report.



MACHINERY AND SUPPLIES

A New Light Motor Truck

In its new line of seven chassis sizes of commercial vehicles for 1916, the Kissel Motor Car Company of Hartford, Wis., springs a surprise in the announcement of a new ¾ to 1 ton worm drive truck to sell for $1,250.

The details of this new truck are given out for the first time and a careful examination of the specifications indicates an unusual value that is declared to have been more than realized in the exhaustive and varied road tests that have been place. It is further stated that this model is being produced in quantity and is ready for immediate delivery at several of the company's leading agencies.

The worm driven rear axle is of David Brown construction, with 56-inch track and 39-inch spring centers. The worm wheel and differential are mounted as a single unit in a cast steel carrier placed in the center housing of the axle. The weight of the truck is carried on heavy steel tubes. In the lower part of the axle housing is a spacious oil reservoir. An automatic oil level and filter plug assures constant lubrication of all bearings. The axle can be disassembled and again assembled without removing it from under the truck.

The engine is a powerful Kissel-built 32-horse-power four-cylinder motor with bore of 3⅞ and stroke of 5½ in. It is cast en bloc. The motor bearings are of the highest quality of white bearing metal, steel-backed and babbitt lined. The valves are of special gage steel, tightly enclosed in compartments that are proof against oil and dust. The valve covers are quickly removable.

The cam shaft is an integral forging of high grade, scientifically hardened and mounted on extra large bearings. The construction allows ready removal of the shaft without disturbing the bushings.

The crank case is built in halves, the lower section removable without disturbing any other part. The crank shaft is an extra large and heavy drop forging mounted on high quality steel-backed and babbitt-lined bearings. All motor parts are thoroughly protected from mud and water.

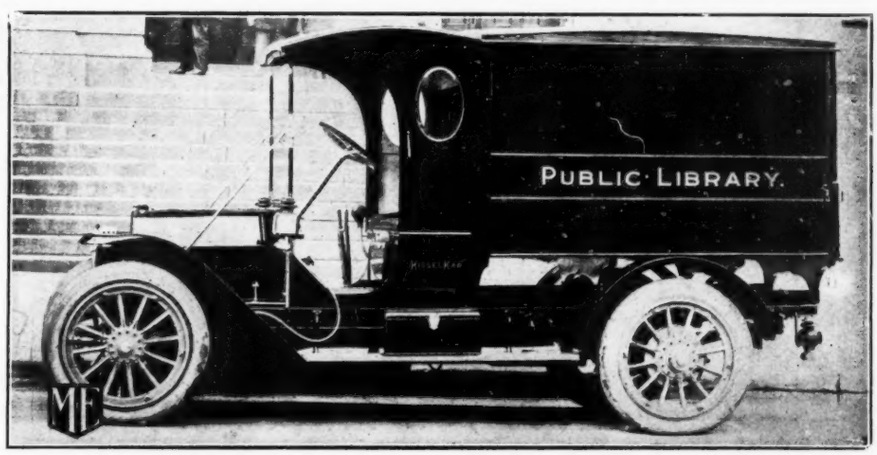
Lubrication is by the perfected splash system, a constant parts are thoroly protected from mud and water.
the oil basin. A positively driven pump forces oil through tubes to a trough passing under each of the connecting rods. Oil is strained each time it enters the pump.

Carburetion is by a highly efficient special carburetor of Kissel design and Stromberg manufacture, mounted high to promote accessibility. The carburetor is fed by the Stewart-Warner vacuum system, which guarantees a uniform and always dependable flow of fuel, does away with all the well-known deficiencies of pressure and gravity feeds and promotes gasoline economy.

The clutch is a cone type, leather faced and with adjustable spring inserts that allow unusually easy and gradual engagement. It is readily reached for adjustment through the floor of the truck, without disturbing any other unit. Drop-forged and heat-treated I-beam section connecting rods; split nut and worm type steering gear; Mayo or Fedders radiator; center control levers and hand throttle; foot accelerator; high tension magneto ignition—these are notable points. The entire power plant is independently suspended at three points and is easily removed.

Both foot and emergency brakes are of the internal expanding type operating on rear wheel, the former by means of a pedal, the latter by hand lever. They are equalized. The transmission is connected with the rear axle through a grease packed spicer universal joint. It has a three speed gearset and is attached by bell housing to motor. The differential is a large bevel gear type.

The speeds are automatically governed, twenty miles being allowed on third or direct drive, five on first and ten on second. The truck has a turning radius of twenty-five feet. The wheel base is 132 inches, tires optional—either 35x4½



KISSEL-KAR *as used by the Milwaukee Public Library for service to branch libraries and the like.*

pneumatic or 34x3 front and 34x4 rear, solid. The wheels are second growth hickory of special commercial vehicle S. A. E. artillery type.

The springs are semi-elliptic both front and rear and built of special alloy steel, the front spring being 2¼ inches wide by 38 inches long, the rear 2½ inches by 50 inches.

A standard express body is furnished for $150 additional or special bodies are built, as desired. If the buyer prefers to have the body built by a local body builder, blue prints are furnished by the factory on request.

The material used and the mechanical details of the other six models of Kissel Kar trucks are similar to the ¾ to 1 ton truck, except that the 1,000 pound delivery is shaft driven and the 2½ to 3, 3½ to 4, and 6 ton sizes are chain driven, that construction being considered best for heavy duty. The 1 to 1½ and 1½ to 2 ton trucks have the David Brown worm drive construction, the same as the ¾ to 1 ton.

Digging a 7-Foot 6-Inch Sewer Trench in Chicago

The W. J. Newman Company have been busy of late with a number of sewer contracts in the heart of Chicago.

The first of these, which was started on August 2d and completed on August 12th, is particularly interesting as the contractor proved in a most convincing maner that it was possible to do the job economically and advantageously with a revolving shovel, many predictions to the contrary notwithstanding.

This contract called for the construction of a 5-foot 6-inch circular brick sewer on Canal street, between Fulton street and the Chicago River and Randolph street, a distance of 2½ blocks.

The first half block at the Fulton street end was dug by hand as railroad tracks prevented shovel work and necessitated tunnelling. The remaining two blocks to Randolph street were dug with an 18-B Bucyrus revolving shovel.

This shovel was mounted on traction wheels and carried a ⅝-yard dipper on a dipper handle 30 feet in length.

The truck ran from 14 to 20 feet in depth, the deeper section on the Randolph street end. The width was 7 feet, 6 inches. The material was a tough blue clay with occasional boulders, a hard material to dig, but one which required comparatively little planking. The shovel gave excellent satisfaction and made an average advance, according to J. T. Carroll, treasurer of the Company acting as superintendent of the job, of from 60 to 85 lineal feet per 100 hour day.

The shovel worked on a set of platforms straddling the trench. These platforms, six in all, were 24 feet long by 36 inches wide. They were made of two 12 by 12 inch timbers 24 feet long armore don the inside by ¼ inch plate. These were separated by another 12 by 12 inch timber 14 feet longo with the center cut away fr the insertion of steel straps on which is hung a ring for handling.

The method of handling the backfill is unusual and most successful. Two wagons are used, designed especially for the purpose, by Mr. Newman. These wagons consist of an ordinary wagon truck on which is mounted a triangular box, the top of which is about ten feet about the ground. The floor of this box is, in effect, a chute strting at the top on the outside and extending at an angle of about 45 per cent. past the side of the wagon, for a distance of about 3 feet. The purpose of this is to chute the material into the trench. This side of the wagon consists of a door hinged at the top controlled by a lever beside the driver's seat. Each wagon has a capacity of 3 cubic yards.

In addition to these two wagons, a 6-yard Knox truck is used.

Beside the shovel crew, there are four men in the trench, shaping for the forms and handling the braces. These men assist in handling th platforms in moving forward. Two men are employed on the backfill tamping.

The two brick layers are assisted by three passers and one man carrying mortar.

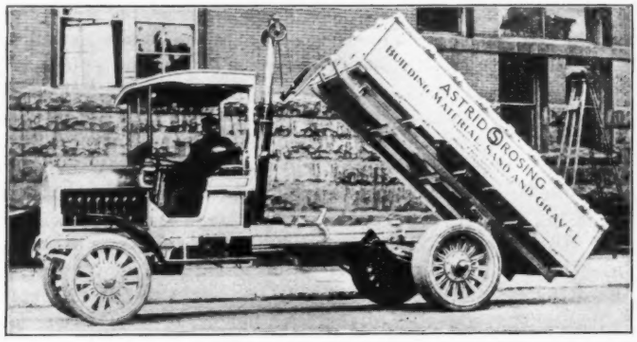
BACK-FILLING *and brick work in progress. Note back-filling wagon in operation.*

As stated, work was started on August 2d and completed on August 12th, five days being lost owing to rain, which speaks well for the management.

The shovel was operated by George Tremblay, craned by Ned Tremblay and fired by Martin Cody. Herb Kent was foreman.

Truck to Deliver Building Materials

The accompany photograph shows a KisselKar truck used by Miss Astrid S. Rosing in the delivery of building materials. Miss Rosing is the only woman who has ever had the courage to engage in the sale of clay products. She reports that the



truck replaces three teams, moves faster than they do and saves about 20 per cent. in cost of delivery. One important value of the truck is in delivering rush orders and her ability to do this, due to her own energy as well as to the use of the truck, is adding materially to the volume of her business.

Chemical Extinguishment of Fires on a Large Scale

The Pittsburg Testing Laboratory has made a technical report on the Thomas automatic fire extinguishing system, from which the following extracts are taken:

While the use, as a fire extinguisher, of powdered bicarbonate of soda, either in dry form or dissolved in water, is not new, these arrangements have been designed only to use on very small fires which were just starting. The quantities of chemical available have been only a pound or two of the powder, or approximately five gallons of solution.

The Thomas automatic fire extinguishing apparatus is supplied with 1,000 to 1,500 pounds of bicarbonate of soda, and a device for feeding this, in regulated amount, into a stream of water which is pumped at high pressure onto the fire. In this way, the fire extinguishing effect of plain water playing on a fire, under high pressure and in large quantities, is greatly increased by the chemical action of bicarbonate of soda. This chemical action consists: First, In the liberation of carbon dioxide to the extent of 26.2 per cent. of the weight of the bicarbonate of soda. Carbon dioxide smothers the flames by excluding air. Second, the liberation of water to the extent of 10.7 per cent. of the weight of the bicarbonate of soda. This liberated water or steam checks combustion. Third, the coating of the wood or other material which is burning with neutral sodium carbonate, which checks combustion. Sodium bicarbonate contains 63.1 per cent. of this neutral sodium carbonate. Fourth, the absorption of heat, due to the breaking up of the bicarbonate of soda into its chemical constituents, has a marked influence in checking combustion.

One pound of bicarbonate of soda contains 0.262 pounds of carbon dioxide, which would be liberated by heat. The gas begins to be evolved below 150 degrees F. Under standard conditions of temperature and pressure (32 degrees F. and 29.9 inches), the volume of this available carbon dioxide gas would be 2.14 cubic feet. At other temperatures, the volumes would be as follows:

At 212 degrees F., it would be 5.83 cubic feet
At 392 degrees F., it would be 7.39 cubic feet
At 592 degrees F., it would be 8.95 cubic feet
At 752 degrees F., it would be 10.52 cubic feet
At 932 degrees F., it would be 13.65 cubic feet
At 1112 degrees F., it would be 15.21 cubic feet

A stream of water amounting to 350 gallons per minute, and carrying 4 ounces of bicarbonate of soda per gallon, would deposit on the burning material 87.5 pounds of bicarbonate of soda, which would liberate, below 752 degrees F., 87.5 by 10.52, or 920.5 cubic feet of carbon dioxide gas, an amount sufficient to smother a very large fire. This quantity of gas would entirely fill a room 10 by 10 by 9 feet, but fire is extinguished when the percentage of carbon dioxide in air rises to approximately 15 per cent., so that fire in a much larger space than the one mentioned above would be extinguished by the air-excluding power of the carbon dioxide which is liberated from the chemical, applied for the brief space of one minute.

From the 87.5 pounds of bicarbonate of soda there would be liberated 9.4 pounds of water, as water vapor or steam. This would act with the carbon dioxide gas in quenching the fire.

There would be applied to the surface of the burning material in one minute, 55.2 pounds of neutral sodium carbonate, which would tend to seal the pores of the burning material from which combustible gases were issuing. It would also hinder or prevent the continued burning of the combustible material at the surface.

Finally, the absorption of heat by the decomposing bicarbonate of soda would be a very considerable factor in lowering the temperature of the burning material below the combustion point. This makes five important factors in the operation of the system: Quenching by water; smothering by the carbon dioxide gas; smothering by the water vapor liberated by the chemical force; sealing and fireproofing effect of the solid, non-volatile chemical; chilling effect caused by the heat absorption when the bicarbonate of soda is broken up by the heat; which explain the high fire extinguishing efficiency of the apparatus.

The apparatus includes, not only the rolling stock and motive power to transport it to the fire, but also pumps and chemical feeding device, making its efficiency independent of a high pressure water supply. Water may be pumped from a river, pond or well in a place where there is no water supply.

The Thomas Automatic Fire Engine Co., 8 East Broad street, Columbus, Ohio, are the makers of the apparatus and will give full information about it.

Trucks Used on Tunnel Job

The illustration herewith shows steam shovel and motor trucks as used in the construction of the Twin Peaks Tunnel, City of San Francisco. This tunnel, which will cost in the neighborhood of $4,000,000 will have an arched roof extending 15 feet above a 30-foot floor, runs 2½ miles thru the hills. It opens up for settlement some of San Francisco's most beautiful territory and will be the main artery of travel between the city and the territory to the south.

The cost of drayage is averaging 26c per cubic yard as against 63c per cubic yard with horses. The net saving will exceed $50,000. The average yardage removed per day of 16 working hours, two shifts, has been 1,000 cubic yards pit measurement, but as high as 1,600 yards have been handled between the tunnel and the dump, 3½ miles distant. Wet weather interfered seriously during March and April, but continuous service was given at all times.

The undertaking will require three years. Goodrich Wireless Tires are on most of the trucks engaged on this work.

The illustration shows a Standard truck in the service. Its ability to turn within the narrow confines of the tunnel; the rapidity with which it receives and discharges its load and the short space of time it takes it to deliver its five tons of earth to the various places where it is used for filling in and other work is effecting a big saving for the contractors.

Fire Prevention Exhibition at Boston

An exhibit of fire prevention apparatus was held at the State House, Boston, Mass., November 12-20, in connection with the Metropolitan City Planning Exhibition for City and Town Advance.

The following were the exhibitors and their exhibits: General Fire Extinguisher Co., Boston; Knight & Thomas, Boston, fire extinguishers; Roofing Association of Massachusetts, including Simpson Bros., F. W. Bird & Son, Waldo Bros. and Standard Paint Co., patent shingles and roof wares; Maine Slate Co., Monson, Mass., specimen roof slates; Pennsylvania Metal Co., Boston, sheet metal for garages and tin-clad doors; United States Steel Co., tables and furniture; Laundry & Fireproofing Co., Lynn, Mass., fireproofed stage hangings; Albion Ferguson Co., Cincinnati, patent fire escape for schools; H. W. Johns-Manville Co., asbestos materials and extinguishers; E. Van Noorden & Co., Boston, wire-glass windows; Sexton Can Co., Boston, safety gasoline and oily waste cans; Flexner-Taylor Co., Boston, fireproof nail course; McNutt Can Co., New York, safety cans; Pyrene Fire Extinguisher Co., Boston, fire extinguishers, cans, etc.; Badger Fire Extinguisher Co., Boston, extinguishers; Kenslea Fire Alarm Co., Watertown, Mass., fire alarms for schools; Standard Oil Co., New York, safety lamps, lanterns and heaters; Rhode Island Supply & Sprinkler Co., Providence, R. I., specimen sprinkler heads.

At the request of Prevention Commissioner O'Keefe, Fire Commissioner Grady, of Boston, installed a sample fire alarm box, which was used in demonstrating the proper manner of ringing in an alarm.

The city planning exhibits included housing plans and photographs, diagrams indicating health conservation work, water works plans, recreation measures, and demonstration of a project for a model city in the southern suburbs of Boston, in commemoration of the three hundredth anniversary of the settlement of Massachusetts Bay.

The program of public exercises held during the exhibition included addresses on city planning, housing, shade trees, harbor development, belt railroads, streets and roads, fire prevention, parks, playgrounds and municipal buildings.

The Carbic System of Lighting

We are illustrating an approved form of Carbic Flare Light, as used in fire departments, street work and general contracting service.

This type consists of three parts: tank, gas bell and cake holder, as illustrated. These lights operate automatically and require no attention for continuous operation other than recharging. After once charged and ready for operation no additional water is required during the entire run, which is not the case with ordinary carbide lights. The gas pressure in the Carbic torches remains uniform thruout their operation, and there are no pumps or moving parts employed in connection with this system to maintain the pressure.

The Carbic system generates gas at an absolutely uniform rate and at no time can excessive and wasteful over-generation occur. The use of Carbic permits the intermittent use of light, and when shut off before exhausting the Carbic in the cake holder, the charge remaining may be left in the machine any reasonable length of time for later use without appreciable loss from after-generation, which is inherent in other systems.

A special type is designed for the use of fire departments and others requiring a compact, light weight generator capable of reflecting a powerful long-beam light. This type

STANDARD CARBIC FLARE LIGHT.

CHARGED. READY FOR CHARGING.

is so constructed that it can be carried in the hand or on the back and has the special swivel joint arrangement which allows the user to swing the reflector to any angle and direct the light in any desired direction.

In order to prevent any splashing of water from the top of the machine when it is being moved or carried it has been supplied with a tight cover, which is quickly removed and easily fastened in place. A novel side vent arrangement eliminates the possibility of the forming of gas pressure and insures the safety of this device at all times. One of the most desirable features, that is well to be remembered in connection with this light, is its ability to penetrate fog, smoke and steam. The Carbic system is controlled by the Carbic Manufacturing Co., Duluth, Minn.

The Ford First Aid Chemical

The Hallock Engineering Co., Cleveland, Ohio, is mounting a standard chemical fire-fighting equipment on a Ford chassis, which unit is intended to serve not only as low-cost and efficient motor-driven apparatus for small villages and towns where insurance rates are usually high because of fire risk, but also as first aid apparatus and chief's cars of larger cities. This unit also serves as motor equipment for fire houses located in the outlying districts of large cities.

MOTIVE EQUIPMENT.

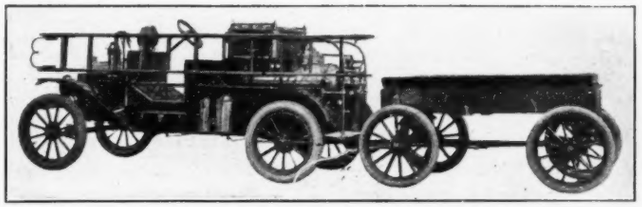
The motive equipment consists of standard Ford chassis, complete with muffler cut out, rebound check springs, brass bar bumper and fitted with oversize non-skid tires (all around). Special body mounting with upholstered driver's seat with two-men capacity, step on rear with one-man capacity. All necessary brackets and fittings for chemical apparatus, ladders, lighting equipment, etc. Wheels, hood and special body painted in department red. Complete tool equipment for car and apparatus, comprising pump, wrenches, screw driver, oil cans, pliers, etc. Metal tool box mounted on running board and additional tool carying capacity in special box under driver's seat. Twelve-inch electric head lights and electric tail light for driving, in addition to special lighting equipment. Nine-inch gas searchlight, adjustable to any position, dash mounted, fitted with thirty-hour gas tank.

FIRE-FIGHTING EQUIPMENT.

The fire-fighting equipment consists of one 35-gallon polished copper chemical tank, of standard approved type, with acid receptacle, agitator, washout spud, overflow valve and pipe, ¾-inch polished brass single by-pass, including pressure gage, controlling valves, water hose connections, etc. Two hundred feet of ¾-inch 4-ply red rubber chemical hose in 50-foot sections, complete with expansion ring chemical hose couplings. One hose basket, fitted with polished brass ends, rollers and corners, with capacity for 200 feet of chemical hose. Two 3-gallon polished copper hand chemical fire extinguishers, with holders and mounting brackets. Sixteen-foot "Steelback" extension ladder, in 9-foot lengths, painted and varnished and slung in brackets. One ¾-inch polished brass chemical shut-off nozzle of standard type. One extra acid receptacle for 35-gallon chemical tank. One soda cannister to hold charge for 35-gallon chemical tank. One canvas soda bag. Eight-foot pike pole or fire hook, with mountings. Six-pound fire ax, with mountings. Eight-pound steel crowbar, with mountings. Two Dietz Fire King oil lanterns, enameled red, with copper founts, fitted with lantern brackets.

FIRE HOSE TRAILER.

A water hose trailer is also furnished, with a patented short-turn gear arranged so that both front and rear wheels turn in the tracks of the rear automobile wheels. The four 30-inch wheels have artillery hubs, 1¼-inch spokes, 1¼-inch wood rims with 1¼-inch channel. The body, which has a



carrying capacity of 1,000 to 1,200 pounds, is sufficient to provide for transportation of several lengths of water hose, additional men and extra equipment. This body measures 6½ feet long by 40 inches wide, outside measurements; 7¾-inch side panels, drop endgate, 5-inch flare boards on each side and front; flareboards are removable.

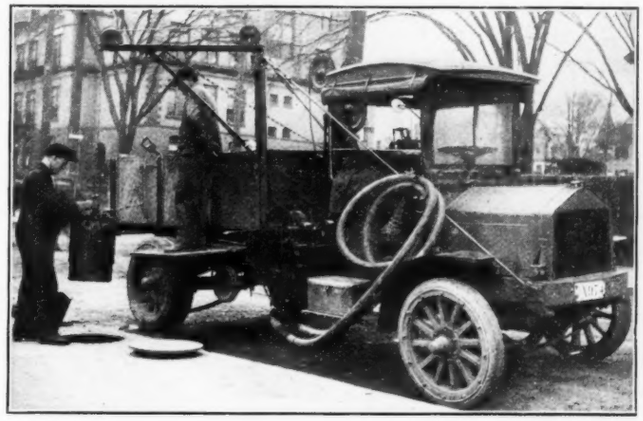
The coupling between the trailer and automobile is arranged so that trailer can be detached instantly by the driver by pressure on floor-board pedal in front of driver's seat on chemical car. It requires but a moment's time to attach or detach the trailer. Trailer will trail backwards as safely as forwards and cannot be upset, owing to the peculiar construction of the gear. Weight of complete trailer, 530 pounds. Height from street to top of floor, 26 inches.

Motor Truck Catch Basin Cleaning

The city of Pawtucket, R. I., has devised a plan whereby a three-ton Standard truck, made by the Standard Motor Truck Company, Detroit, does the work of six horse carts and twelve men in cleaning out the catch basins of the city. Not more than three men are required to work the truck and accomplish the same results.

The chassis does not differ materially from that regularly supplied by the maker. The body was built by the Monahan Vehicle Company, Providence, R. I., and embodies some of the ideas presented by Commissioner Gill. The entire outfit is designed to lower buckets into the sewer basin, there to be filled and then hoisted and dumped into the body of the vehicle. When the latter is filled, the machine is arranged to dump the entire load in forty seconds, so that there is a material saving in time, as well as labor.

Directly back of the driver's seat is a two-horse-power single-cylinder auxiliary engine, geared to a hoisting drum from which a cable is run thru the center of the crane and over pulleys on the arm. This engine draws its fuel supply from the same source as the regular motor which propels the truck, and the exhaust is arranged to communicate with the muffler. The water circulation is connected with the radiator, so that the two engines utilize practically the same system. At the front of the body is an hydraulic hoist for dumping the load, this comprising a long cylinder with a piston forced upward by oil from a gear pump, which is driven by a connection in the transmission case.



The mechanical details were worked out by James Nesbit, who is in charge of the motor apparatus utilized by the department of public works.

Cement Gun Construction

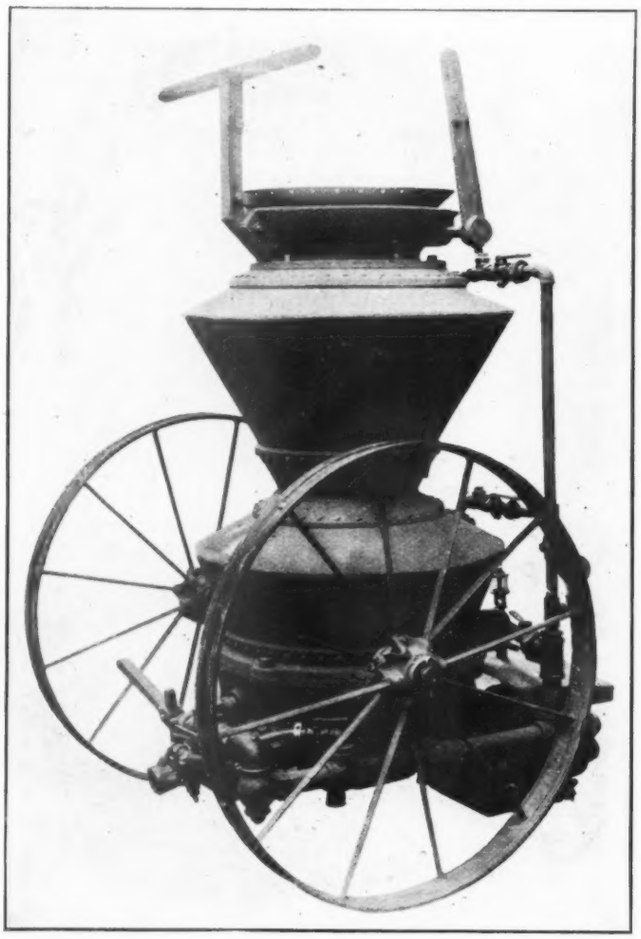
We are illustrating type N-2 Cement-Gun as recently used on the repair of the city of Nashville, Tenn., reservoir and the waterproofing of the Elephant Butte dam, New Mexico.

This same type was used in the construction of the Hospital for the Insane, Whitby, Ont.

In the cement gun process, since hydration takes place during the application of the mortar, the cement is in its final resting-place when the setting process begins, and there is nothing to interrupt that continuity of hardening recognized by the best authorities as essential to strength of product.

It might be thought that a considerable quantity of material would rebound from the receiving surface and that this rebound would prove a serious loss. In practice, however, it has been found that while a certain proportion of the projected material does rebound, the rejected material consists almost entirely of sand and water. And since rebounding sand can be used again by drying out, no loss of material need be sustained from rebound. Furthermore, it has been demonstrated conclusively that this apparent loss by rebound is in effect a beneficial factor, it being a natural and selective fore-runner of a dense and homogeneous mass.

The cement gun discharges the mortar with a nozzle velocity equivalent to a pressure head of 35 pounds, so that the cementitious material impinges with considerable force upon the surface to be coated, penetrates intimately the surface irregularities, and so insures an almost perfect adhesion.



A cement gun, similiar in principle to the type illustrated, was used in the waterproofing of the Pavonia Avenue Station of the Hudson and Manhattan Railroad in Jersey City, N. J. Hudson River silt, which is a finely pulverized clay with a considerably larger portion of silica than ordinary clay, was dried and mixed with equal proportions of portland cement, applied through the medium of a cement gun as a heavy coating on every portion of exposed timbering and lagging in the tunnel. This produced a layer of impervious plaster about two inches thick against which the concrete lining of the tunnel was placed. The method was proved successful, the station structure being practically dry under an extreme head of salt water.

Making the Diaphragm Pump Equal to the Engine

The new Atlantic diaphragm pump has been vastly improved by improving the pump and its connections with the engine so that the pump is made equal to the engine in efficiency.

The old 4-inch diaphragm pump sometimes splashed. It was found by experimenting that the splashing was largely due to the fact that the upper valve was fixed on one side and when the valve returned, it slapped the water in such a way as to splash it over the top of the pump. Therefore a vertical valve was designed, which rises clear, allowing the water to escape on all sides. In making this improvement, another thing was acomplished, which is much more important, that is to say, it was found that the freedom of action in the valve increased the capacity of the pump to nearly double that of the pump with the fixed valve. The best results from the the earlier pump gave 100 gallons of water a minute; the pump with the new valve, under the same conditions, gives 189 gallons of water per minute. The improvement is very clearly shown, as the pump is now made, in a drawing on the back inside cover, which will appeal to the contractor as showing a very efficient pump of this sort.

Other new feature in Atlantic engines and pumps are shown in pamphlet B-1 of the Harold L. Bond Co., 383-391 Atlantic Avenue, Boston, Mass., who are old and well-established manufactureds of many time and labor-saving specialties for contractors, municipalities and corporations.

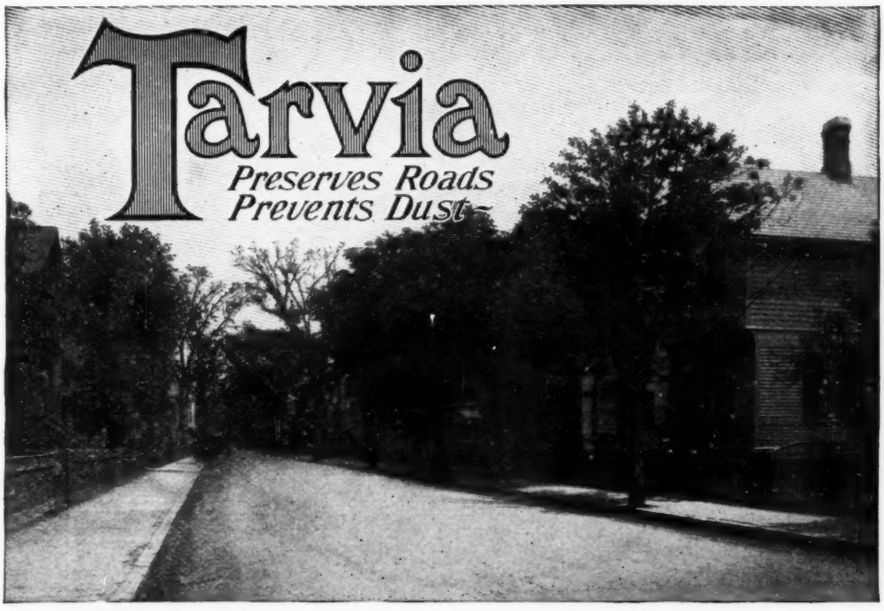
The Ross Precision Computer

The Ross precision computer is a new multiplier-and-divider of unusual precision. It solves problems like 879.65+72.638÷74.769=854.58,—with an accuracy of 5 figures, i. e. to an ultimate accuracy of 1/1000 of 1 per cent., or 1 in 100,000. It is 100 times as accurate as the slide-rule;—if a slide-rule were made 100 feet long and graduated with spaces no greater than the ordinary 10-inch rule, it would still be less accurate than the precision computer.

It consists of a graduated dial rotating under a slotted cover, a floating guide, and a slide mounted at the right of the slot. The dial carries a scale of numbers reading to 5 significant figures thruout, like 24364, 67342, 99893. The slide carries a miniature of the dial scale, reading to 3 figures, and co-operates with the dial, checks and points out the precise answer, and locates its decimal point. For instant approximate results the slide alone may be used, much more directly and simply than the ordinary slide-rule.

To multiply and divide any series of numbers, it is only necessary to set each number in succession under the reading line in the slot; when the last number has been set the answer appears, also under the slot-line. Powers, roots and complex expressions may be solved by the computer with great rapidity and precision.

At the left of the slot is a scale of equal parts;—it co-



Columbia Street, Cambridge, Mass.
"Tarvia-X", 1909.

The Story of Columbia Street—

Seven years ago this street was re-surfaced with 2½ inches of new stone and "Tarvia-X". The work was crudely done judged by modern standards, but nevertheless has proved an excellent investment for the city of Cambridge.

It affords a peculiarly difficult test, for the street is only 22 feet wide and carries a concentrated traffic of 4,000 to 6,000 vehicles per day, giving probably the heaviest traffic per foot in width endured by any street of the kind in the United States. In comparison with the traffic the annual maintenance expense is insignificant, consisting simply of a coat of "Tarvia-B" applied once a year.

What the city authorities think of Tarvia is evident by the large extensions of Tarvia work that have been made yearly in Cambridge.

The use of "Tarvia-X" in the original re-surfacing work added little to the cost of the job but added six years to the life of the road, for plain macadam with its tender, quickly-abraded surface would have worn out within a single season under such traffic and the dust nuisance would have been acute.

In other words, by using Tarvia as a binder the re-surfacing job has already lasted seven times as long as it would otherwise have lasted and it has not worn out yet.

"Tarvia-X" is a viscid coal tar preparation which is applied hot. It is inherently proof against water and frost and has great bonding power. It encloses the stone in a tough matrix and makes the road automobile-proof.

"Tarvia-B" is a lighter grade which is applied cold at a very low cost per square yard.

There is a grade of Tarvia and a Tarvia specification for every macadam road problem.

Illustrated booklet on request.

Special Service Department

This company has a corps of trained engineers and chemists who have given years of study to modern road problems.

The advice of these men may be had for the asking by anyone interested.

If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will have prompt attention.

BARRETT MANUFACTURING COMPANY

New York Chicago Philadelphia Boston St. Louis Cleveland Cincinnati Pittsburgh
Detroit Birmingham Kansas City Minneapolis Salt Lake City Seattle Peoria

THE PATERSON MFG. CO., Limited: Montreal Toronto Winnipeg Vancouver
St. John, N. B. Halifax, N. S. Sydney, N. S.

operates with a similar scale at the rim of dial to give directly 5-place logarithms and anti-logarithms. This abviates fingering pages of tables, mental interpolations, errors, and forms, in fact, a complete graphic table of 5-place, interpolated, logarithms. Trigonometric calculations made with the precision computer give an accuracy of 3 to 5 seconds of arc. On the ordinary slide-rule, the distance between two graduations, 98 and 99, is 1/46 inch, and the distance between the same two graduations on the computer is 2¾ inches.

The system of graduations is uniform thruout and extremely simple, like a 10-to-the-inch scale. The graduations are clear and open, obviating eye-strain and use of magnifiers. Anyone may use the precision computer at first sight, without any previous preparation, by merely following the succinct directions given on the face of the instrument. The use of the instrument does not require any knowledge of mathematics or logarithms, it reads as plainly as a clock-dial or a foot rule. Proficiency can be obtained in a few hours.

The precision computer combines the accuracy of 5-place, interpolated, logarithms, with the speed and convenience of a slide-rule, without the drawbacks of either. Its accuracy is ample for all precise engineering and statistical calculations. Those familiar with the slide-rule will marvel at the great accuracy attainable with the precision computer, the convenience of having a uniform system of graduations with a uniform accuracy thruout, and a computer that gives either approximate or precise results, as desired.

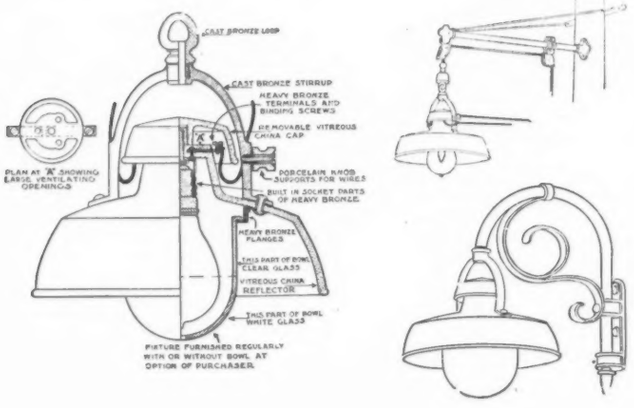
It is sold by The Computer Mfg. Co., 25 California St., San Francisco, Cal., at $12.25 in cloth case or $13.75 in round leather case.

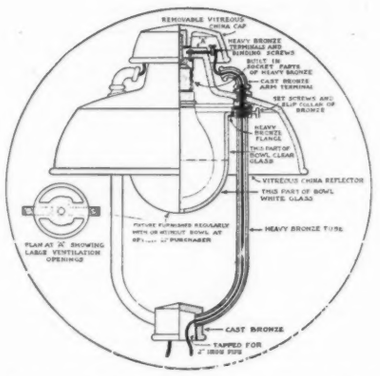
New Type Lighting Fixture

The lighting fixture illustrated herewith and known as the "Dayway" has recently been produced by the Luminous Unit Company, of St. Louis. It is produced in two forms, one for suspension from brackets, mast arms, cross spans, stems, etc., the other for mounting on ornamental or plain post. Either of the types is supplied with a partially clear and partially diffusing glass enclosing bowl which encloses the lamp, affording optical protection as well as mechanical protection to the lamp. This bowl is supplied as optional equipment, the distribution characteristics being approximately the same in either case. Exposed or concealed wiring may be used with either type of fixture as duct space is provided in the supporting structure as well as arrangements for mounting insulators.

Constructional features of this new unit are of particular interest in view of the fact that a consistent effort has been made to produce a unit which will not only be highly efficient, but which will be virtually indestructible under any service conditions.

The reflector and cap are of vitreous china of sufficient weight to resist a heavy blow without breaking, thus insuring


CAST BRONZE LOOP
CAST BRONZE STIRRUP
HEAVY BRONZE TERMINALS AND BINDING SCREWS
REMOVABLE VITREOUS CHINA CAP
PLAN AT 'A' SHOWING LARGE VENTILATING OPENINGS
PORCELAIN KNOB SUPPORTS FOR WIRES
BUILT IN SOCKET PARTS OF HEAVY BRONZE
HEAVY BRONZE FLANGES
THIS PART OF BOWL CLEAR GLASS
VITREOUS CHINA REFLECTOR
THIS PART OF BOWL WHITE GLASS
FIXTURE FURNISHED REGULARLY WITH OR WITHOUT BOWL AT OPTION OF PURCHASER


REMOVABLE VITREOUS CHINA CAP
HEAVY BRONZE TERMINALS AND BINDING SCREWS
BUILT IN SOCKET PARTS OF HEAVY BRONZE
CAST BRONZE ARM TERMINAL
SET SCREWS AND SLIP COLLAR OF BRONZE
HEAVY BRONZE FLANGES
THIS PART OF BOWL CLEAR GLASS
VITREOUS CHINA REFLECTOR
THIS PART OF BOWL WHITE GLASS
HEAVY BRONZE TUBE
PLAN AT 'A' SHOWING LARGE VENTILATION OPENINGS
CAST BRONZE
TAPPED FOR 1" IRON PIPE

them against accidental or intentional blows which might be inflicted. Vitreous china is absolutely impervious to all action of the elements, sulphurous fumes, etc., and is, therefore, virtually indestructible.

All metal parts used in the construction of the fixture are of pure copper or bronze of heavy gage, sheeet metal or cast, thus insuring extraordinarily long life and absolute freedom from corrosion.

The fixture is perfectly ventilated, two holes being provided in the top of the neck under the cap, which permits of the passage of a current of air for cooling the lamp up along side the lamp and receptacle and out under the cap, this allowing as it does the lamps to operate at their normal temperatures is productive of long life in the lamps.

All emitted light is directed to the working plane, hence th utilization factor is high. The adaptability of this unit to lamps of high candle power makes it possible to reduce the number of units normally required to the block.

It is furnished for either multiple or series circuits. When used on series circuits it is only necessary to remove burned out lamp to renew film cutout, no part of socket or receptacle need be removed as is normally the case with series units.

This facilitates lamp renewals in case of burn outs. The only change necessary for adaptation from multiple to series circuits is to change the center contact and provide each unit with a series adapter which fits on the base of the lamp, therefore, existing multiple systems may be converted at any time to series system at a very low cost so far as the units are concerned.

Street Cleaning and Sweeping Machinery

The recent street cleaning exhibit in New York City brought together many machines for this purpose.

Perhaps the best exhibit was that of the Tiffin Wagon Co., Tiffin, Ohio, who showed motor-drawn and horse-drawn flushing machines, automatic and pressure.

The Studebaker Co., South Bend, Ind., showed ash and garbage wagons, street sweepers, sprinklers and flushers.

The Kindling Machinery Co., Milwaukee, Wis., exhibited their efficient squeegee street washer and also a sand spreader for use on slippery streets.

The American Car Sprinkler Co., Worcester, Mass., was on hand with their new electric car flusher.

The Austin Mfg. Co., Chicago, had a two-speed sprinkler-sweeper machine and an oil sprinkler.

The Universal Road Machine Co., Kingston, N. Y., showed their Reliance sweeper, which is one of the standards of the market.

Elgin Street Sweeper Co., Elgin, Ill., showed their sprinkler-sweeper-pick-up motor-driven machine, which sweeps streets at a cost of 12 cents per 1,000 square yards swept.

Knox Motors Co., Springfield, Mass., were there with a Knox tractor with trailer.

BITULITHIC KEYNOTES—

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Bitulithic affords *comfort* to automobile owners.
Bitulithic prevents skidding, thus giving *safety* to automobiles.
Bitulithic is best and is *economy* for you to lay as it will outwear all inferior bituminous pavements which are said to be the same as

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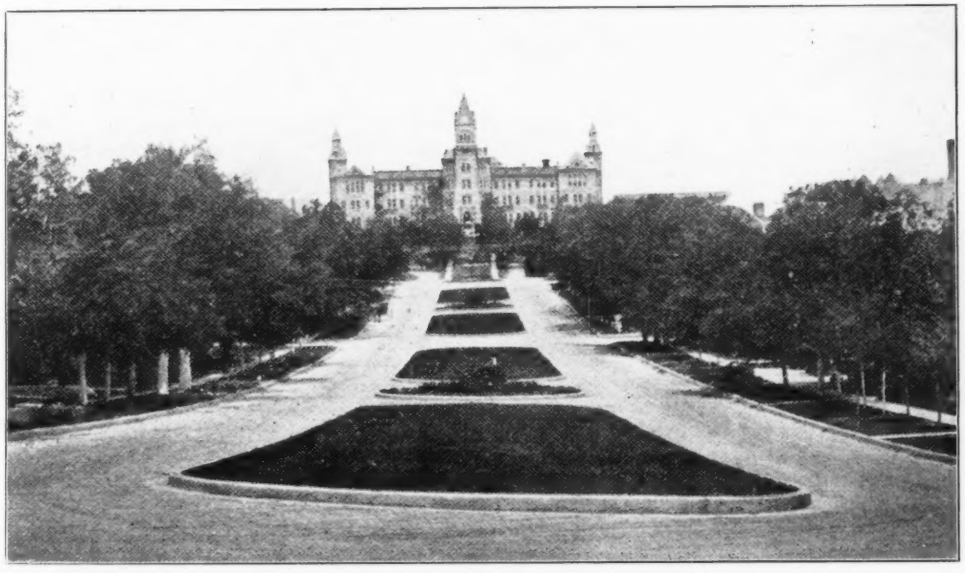

Bitulithic Pavement, University Avenue, Austin, Texas. Showing the Texas State House in back ground.

STOP AND THINK—

Does it not occur to you that the density and inherent stability of the **Bitulithic** —made of varying sizes of stone combined with bituminous cement—is the pavement you should have, and the one the city will save money on in the end?

It is worthy of your consideration

The fact that over 300 cities throughout the United States and Canada have adopted **Bitulithic** as a standard construction to the extent of over 2100 miles of roadway 30 feet wide between curbs.

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Good Roads Machinery Co., Kenneth Square, Pa., showed snow plows, and Garford motor truck with snow plow attachment.

Charles Hvass & Co., 509 East Eighteenth street, New York, showed motor power flushers, sprinklers and sweepers, etc.

Wirt & Knox, York and Twenty-third streets, Philadelphia, Pa., showed street cleaning hand apparatus, scrapers, brushes, refuse cans, can and bag carrier, etc.

General Vehicle Co., Inc., Long Island City, New York, exhibited gasoline electric tractor.

Merritt Street Sweeping Machine Co., 523 East Eighteenth street, New York, exhibited a horse-drawn street sweeping apparatus, using brushes, picking up the sweepings and depositing them by conveyor in cars.

The Model Refuse Collection System, Inc., 61 East Fourth street, New York, explained the dustless and odorless collection system, with Ochsner wagons and cans, described fully in our article to be found elsewhere in this number.

W. W. Harris, 45 Broadway, New York, also showed a dustless refuse collection system, with special motor-drawn truck and dustless cans.

Leon Altschul, 1000 Fox street, Bronx Boro, New York, showed metal ash and cart covers to be attached to open ash and garbage carts to prevent dust and odors.

George B. Marx, 204 Newell street, Brooklyn, N. Y., showed trailers for motor tractors.

Trade Notes

The Indiana Paving Brick Publicity Bureau is composed of eleven manufacturers of vitrified paving brick in Indiana and eastern Illinois. It has entered upon a campaign of education and publicity which includes a field engineer, news articles and advertisements in the local press, and all other legitimate methods of showing the builders of good roads and streets and those paying for such highways the advantages of brick as the wearing surface.

MacArthur Concrete Pile & Foundation Co., 11 Pine street, New York, has been awarded contracts covering concrete pile foundations for the following: Grain elevator, Standard Tilton Milling Co., Alton Ill.; mill building, Paterson Parchment Paper Co., Passaic, N. J.; factory building, Electric Auto-Lite Co., Toledo, O.

W. W. Dixon, the originator of the water-tight flexible sewer joint, is now in charge of the pipe joint department of The Atlas Company, Lincoln, N. J., and as such is still engaged in promoting the use of G-K. pipe joint compound. Infiltration and leakage in sewers is the subject of a pamphlet which he will send on request.

Yeoman's Brothers Company, 231 Institute Place, Chicago, Ill., have taken charge of the sale and installation of the well-known Shone pneumatic sewage ejectors for the United States and Canada, and have added it to their list, which includes centrifugal ejectors, bilge pumps and other lines of pumping machinery.

Trade Publications

Leaflet 151 catalogs the outlet boxes and covers of the Steel City Electric Co., Pittsburg, Pa.

Carr-Mesh is the title of a 64-page booklet of the Corrugated Bar Co., Buffalo, N. Y., descriptive of one of their methods of concrete and plaster reinforcement and support.

The Exposition booklet of the Solvay Process Co., and Semet-Solvay Co., Syracuse, N. Y., is a handsome showing of Solvay rust-resisting paints for protecting iron and steel.

Solvay stack paint is the subject of a circular of the Solvay Process Co. It can be relied upon up to temperatures about 750 degrees F.

A positively locking, jointed sewer rod, each joint with or without wheels, is illustrated and described in a circular distributed by W. H. Stewart, 1616 Locust street, St. Louis, Mo., who also sells sewer cleaning machines.

The International Motor Co., New York, has issued a most interesting report of the operation of Mack trucks in the war maneuvers at and near Plattsburg, N. Y., of which so much was published during the summer.

Bulletin G, No. 3, of The Sanitation Corporation, New York, fully describes the use of the Riensch-Wurl screen for the clarification of sewage and trade wastes.

Grinnell Automatic Sprinkler Bulletin for October has been received.

Two very handsome booklets illustrate the manufacturing establishments of J. & C. G. Bolinders at Stockholm, Sweden, and elsewhere, where are made boilers, steam engines and turbines, oil engines, various classes of machinery, castings and engineering specialties, and the application of crude oil engines as auxiliary power on sailing vessels. The representatives in this country are the Bolinders Company, 30 Church street, New York.

The standard specifications for portland cement adopted by the American Society for Testing Materials are issued in convenient pamphlet form by Robert W. Hunt & Co., Engineers; Main Office, Chicago, Ill.

Plants for washing sand and gravel are described in much detail in a book issued by the Raymond W. Drill Company, Chicago, which also contains photographs of a large number of plants using their system.

Kahn building products for railroad structures are itemized in a pamphlet issued by the Trussed Concrete Steel Company, Youngstown, Ohio, which also gives photographs of many railroad stations, shops and other buildings and bridges, trestles, tunnels and tanks in which they have been used.

Reo Motor Trucks, especially the 2-ton Model J, are the subject of a pamphlet issued by the Reo Motor Truck Company, Lansing, Mich.

The Berger Manufacturing Company, Canton, Ohio, has issued a well-designed booklet on concrete reinforcing and furring plates.

Farm wagons is the subject of Catalog No. 600 of the Studebaker Corporation, South Bend, Ind.

The "Chicago Pneumatic" Tool Company has issued Booklet No. 213, describing the new Simplate flat disc valve. This valve, unlike any and all other valves, is unique and distinctive in both design and construction. Its chief advantages are—that it is simple; that its plates are independent in action, one of another; that the tension of the springs on the inlet and discharge valves differs according to the density of the air handled; and lastly, that it is applicable to all positions and conditions. "Simplate" valves are remarkably simple, since they have independent plates and springs, and a varied opening, according to speed. At low speed, one plate acts; at high speed, all operate; hence, the action is ideal under all speed conditions. These valves are silent in operation at all speeds, resulting in little wear and long life; they are equally suited to high and low pressure, and the cost for repairs is reduced to a minimum; they insure higher mechanical and volumetric efficiencies than the old-style poppet valves; they assure continuous operation under the severest conditions; and the air compressing cylinders are simplified, due to the absence of all intricate valve operating mechanism; the valves require no lubrication; the compressor floor space and cost of installation are lessened because of the possibility of getting a greater capacity from a given machine when operated at high speed; and lastly, the valve plates, as well as all other parts entering into the complete unit, are perfectly interchangeable.